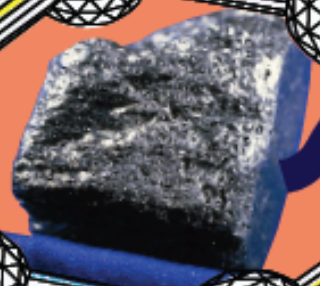
GRAPHITE

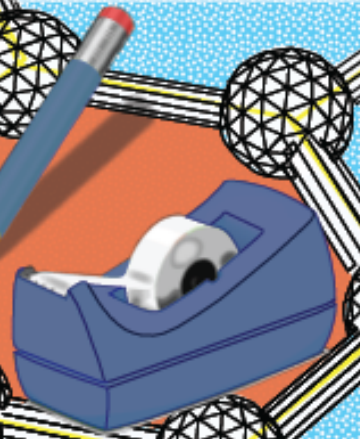


What is Graphite?

Found naturally in metamorphic rock as well as igneous rock and meteorites, the mineral graphite is an allotrope of carbon. Graphite is the most stable form of carbon under standard conditions and occurs in many forms such as bulk, planar (graphene), sp^{2} (carbon nanotubes), and spheres (buckyballs or fullerenes). With a layered, planar structure - the carbon atoms are arranged in a honeycomb lattice that are 0.142 nm apart and at distance of 0.335 nm between the different planes. The vast delocalization of electrons within the carbon layers enables graphite to conduct electricity.

What is the History?

The Native cultures used natural graphite to create a ceramic paint for decorating pottery during the Neolithic Age in southeastern Europe. During the early 1500s, an enormous deposit of graphite was discovered in Borrowdale parish, Cumbria, England - Borrowdale graphite was used as a refractory material in molding cannonballs during the reign of Elizabeth I of England. Similar to coal, natural graphite is extracted from open-pit and underground mines. Modern-day uses of natural graphite



Then, What is Graphene?

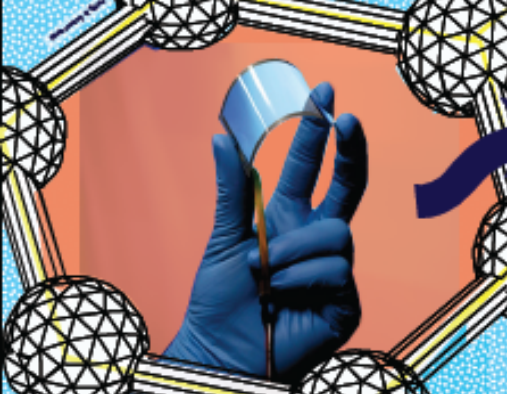
Graphene, which occurs naturally in graphite, is the thinnest substance ever made. It is a single sheet of hexagonal carbon atoms arranged in a honeycomb lattice structure. Despite its tiny size, graphene has some incredible properties. Aside from being physically strong, high quality graphene is incredibly light, nearly transparent, and is such a good conductor of heat and electricity that electrons flow through it faster at room temperature than any other known material. First isolated in 2004 by Andre Geim and Konstantin Novoselov at the University of Manchester using "the Scotch tape" technique, many have proposed dozens of ambitious applications for graphene over the past decade.

Applications of Graphene?

Researchers want to harness graphene's unique abilities and apply them in varied fields such as medicine, computer science, biotech, enamel protection, alcoholic beverages and much more. Graphene-enhanced PCR (polymerase chain reaction) is 10x productive. Due to its high carrier mobility, this special material can be used in integrated circuits or the channel in a field-effect transistor. Additionally, graphene nanoribbons have the potential to replace silicon as a semiconductor. Due to its heat flexibility, graphene transistors can be printed on flexible plastic which can be misrepresented and easily folded up - the implications of said applications could change the way we interact with our smart gadgets. Can you imagine a smartphone that could de-yoga better than you? If you aren't already impressed by graphene, wait until you hear how it can make alcohol-even better! Graphene oxide membranes allow water vapor to pass through but are impermeable to every other liquid and gas which allows for the distillation of higher concentrations of vodka. And if alcohol isn't your thing, research suggests that graphene filters could outperform current techniques of water desalination.

What's Your Personal Entanglement?

If you were to isolate random moments over the past 10 years of my life, you would find that graphite is omnipresent. When I was five, we had just come here from Vietnam so I didn't understand the language or the culture; the only thing that wasn't foreign to me was drawing. I cannot attribute my calling to art alone but it has been a ubiquitous aspect of my development. The solid feeling of having a pencil in my left hand is indescribable and it's interesting to be at a point in my life where I can study graphite in such a different way. Looking forward, all I know with absolute certainty is that graphite will continue to have reign over much of my life, not simply just because of art. There are steady advancements that will soon redefine current and quickly emerging factors from medicine to graphene processing. Whatever my career is, it will be entangled in



Are There Limitations?

But there's a HUGE All there wonderful and world changing applications are in a complicated relationship with graphene. While the constraints of our current technological era, graphene is difficult to produce on a more and more economical scale. There is a lot of potential to be had with limitations concerning and revolving around this tiny material and its unique properties but the pooling of synthetic graphene does not seem to have a simple process that can be scaled up. As the demand arises from consumers and financial backers alike, new research and techniques will arise enabling further development. It is interesting to consider the entanglement between our current society with graphene because this material holds a vision of the future that many of us can only imagine but unfortunately, we

[redacted]

MITSUBISHI PLASTICS

Polymers & the Plastic Paradigm

[redacted]

University of Florida , Impact of Materials on Society

Polymers

The history:

1500's: British explorers discover the Mayan civilization in Central America. The British find children playing with balls made of rubber from the local rubber trees.

1839: Charles Goodyear discovers vulcanization, by combining natural rubber with sulfur and heating it to 270 degrees Fahrenheit.

1907: Leo Baekeland creates Bakelite, predominantly used as an electrical insulator.

1917: X-ray crystallography is invented allowing M. Polyanyi to discover the chemical structure of cellulose. This discovery added to the understanding of long chain molecules.

1920: German chemist Hermann Staudinger publishes "Uber Polymerization." Introduced the public to polymer theory.

1927-today: Large scale production of vinyl-chloride resins begin.

1930: Polystyrene is invented.

1938: Wallace Carothers at Dupont create Nylon.

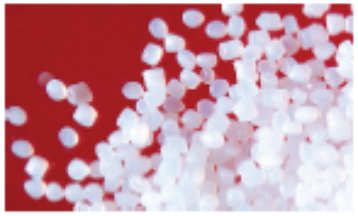
1941: High density and low density Polyethylene is created.

1970: James Economy develops a moldable high temperature polymer "Ekonol."

Polymers 1976:

In 1976 the polymer/plastic industry surpassed steel as the nations most widely used material per unit volume. We now manufacture more plastic than steel, aluminum, and copper combined.

According to a recent release from Plastics Europe, a team of over 100 plastic manufacturers, claims that they are responsible for 90% of all the polymer production across the 27 EU member states.



The Big Six

- Polypropylene (PP)
- Polyvinyl chloride (PVC)
- Polystyrene solid (PS), expandable (PS-E)
- Polyethylene terephthalate (PET)
- Polyurethane (PUR)
- Polyethylene – including low density (PE-LD), linear low density (PE-LLD) and high density (PE-HD)

Recycling Code	Abbreviation	Name Of Polymer	Common Uses Of Recycled Product
1	PET / PETE	Polyethylene terephthalate	Polyester fibres, soft drink bottles.
2	HDPE	High density polyethylene	Bottles, plastic carrier bags, recycling bins.
3	PVC / V	Polyvinyl chloride	Pipe, fencing, non-food bottles.
4	LDPE	Low density polyethylene	Plastic bags, containers, dispensing bottles.
5	PP	Polypropylene	Auto parts, industrial fibres.
6	PS	Polystyrene	Coffee cups, toys, video cassettes.
7	OTHER	Other Plastics	Various.

www.plasticsnews.org

Phthalates : Used as plasticizers

Polymerization technologies dominate the markets. From the interior of your car to the diaper attached to an infant, we are truly living in the "age of plastics." Polymers can have wondrous and unique properties and take on many shapes.

- Recipes for polymers have been big talk throughout the intellectual property debate.

- These chemical recipes are now considered proprietary.

- Recycling code information is completely voluntary.

Local Impacts

I recently worked with FWC (Florida Fish and Wildlife Conservation Commission) on a number of projects ranging from land GIS mapping, gopher tortoise burrow surveys, and monitoring and upkeep of designated tern breeding areas. The least tern is a small endangered shore bird who nest on beaches throughout Florida's coastline.

What does this have to do with plastics?

While spending allot of time out by the shoreline conducting these chores we would inevitably come upon piles of trash. These mounds where gathered from across the beach about one-hundred yards apart. The majority of this waste was of course, plastics. The beaches are privately owned government land near the Hobe Sound Inlet on the southeast coast of Fl. Strong currents and frequent coastal storms make the beaches here a collection trap for human consumer plastic waste.

After collecting heaps of large plastic debris I began to look closer. After taking a 1x1 surface sample I began combing and separating the plastic debris. Nurdles (max. 3/16 in. or 5mm) and small fragments made up a majority of the plastics collected.

These particulates are an environmental disaster. The chemicals leached have entered the human food chain. They are detectable in rain water as well as most industrialized water supplies. The shift to polymers was a silent revolution, transforming and shaping the built world we enjoy today. Phthalates such as BPA (Bisphenol A) or DEHP (di-2-ethylhexyl phthalate) are measurable in the tissues of homo Sapiens. The impact of this material is chronic, meaning you're constantly coming into contact with it. From the moment you wake up, the clothe you put on, and the bed you inevitably fall back into owe their cozy affordability to polymerization.

Designing the future

Since the dawn of stone tools around 2.5 million years ago humans have created. In doing so, we started to discover new materials, new ways of working these materials, and ultimately creating our own materials.

Materials science is booming, to say the least and polymer production is at an all time high. We are surrounded by our things. We rely on our things, and our things rely on us. Polymer technology has taken us quite literally to other worlds. Allowing builders to design and create some of the most powerful tools imaginable.

As an anthropologist I am left with a sort of awe when pondering the true impact of materials. When we study past and present civilizations we focus on the tools and materials present to extract inferences as to how the society functions. We are defined by the tools and materials we use. We have built entire cultures around particular materials. We are entangled to our things and there's no going back now!

We as a University must focus on bridging the communication divide between scientific fields. To truly understand the human condition we must realize and work towards a fully integrated interdisciplinary network. To build a sustainable future we must start with discovering the past. Materials science and the humanities are becoming more complimentary each day especially in the industrialized world. With a growing dependence on information technologies we have created the perfect scenario for complementary study. Materials today have left the industrial mills and found their way into our homes. With the growing availability of material technology we are individually deciding how we ourselves define our tools.

How will the future of materials define us?

The Perception of Plastic

Photo Essay Project - [redacted]

Introduction

Plastics are widely used in a variety of applications in the world today. They are easy to produce with very low cost. They are also easily customizable and therefore are able to have such a wide range of applications. Plastics are made of polymers, which are long chains of molecules in repeating units. Therefore scientists can take advantage of this property in order to create materials that have great durability and flexibility. These plastics can also be reinforced with other materials in order to fit the demand and need of society.

The Impact Paradigm

Material: Plastics are polymers with additive to improve its properties in the desired way. Polymers are a long chain of molecules that have repeating units. Plastics have a high strength to weight ratio, are resistant to corrosion, can be colored or transparent, have good durability, are water resistant, and are low cost.

Historical: A natural form of a polymer was gutta percha, which was a natural rubber. This along with bitumen and silk were among the first polymers that were used. The plastic age started in the 1830s with Goodyear who worked to improve the qualities of rubber. Later in the 1930s, Fawcett and Gibson accidentally polymerize ethylene and this eventually led to the discovery of the applications of low density polyethylene (LDPE) and polypropylene (PP), which are both used to make Tupperware.

Technological: Scientists were able to learn how to synthesize many different polymers and this opened the door to a wide range of applications. Some of these applications are found in Tupperware, clothing, carpeting, medical devices, rope, care batteries, waste baskets, pharmacy prescription bottles, Teflon, nylon, neoprene, etc. Because of the low production cost, water resistance, and versatility, plastics replaced many traditional materials such as wood and metal in many of their former uses.

Societal and Cultural: Today, packaging is the largest single use of plastics, due to its weight, flexibility, and sealing qualities. However, there are many environmental implications of plastic materials, since they are non-renewable materials. High volumes of plastic materials are consumed each year (100 million tons), but only a small percent of it is actually recycled (<10%). Not only is the final product harmful to the environment, the materials that are used to create plastics are equally as dangerous and can create toxic waste. Compared to paper grocery bags, it costs less and consumes less energy to create plastic bags, however a single plastic bag can take up to 1000 years to degrade. Because plastics cost very little to produce, there is a social stigma of plastic being viewed as cheap and not high quality.

The Use of Plastic in Credit Cards

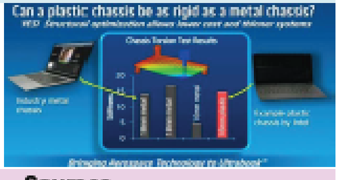
Traditionally, credit and debit cards are made of plastic. This is because the card itself it not valuable. All the perceived value of the card comes from the intangible sum of money that is linked to it. Credit cards are not stolen for the card in itself, but for the virtual access to money. However, recently many banks have started making special credit cards that are made of precious metals instead of plastics. Examples include Chase's Sapphire Preferred Card, American Express' Centurion Card, and Sherbank's Visa Infinity Gold Card. Varying in degree, these special credit cards are only available to those who qualify; loyal card holders with a lot of money in the bank. Cards like these are described to have "the plunk factor," and definitely attracts much attention from all those around. These cards are advertised and designed to display that they have more value, both literally and virtually.

The usage of metal in the cards in place of plastic to indicate a greater value points to the social impact on the perceived value of materials. Because metals are rarer, to make a credit card out of metal instead of plastic, while unnecessary, upgrades its worth. The Chase Sapphire Preferred Card is advertised to be a card "of a different color". The advertisement shows a procession of very cheap products (such as a toothbrush) being spray painted in gold, and then at the end, there is an image of the Sapphire Preferred card. The tagline of the ad is that "not all things that are gold are worth more," which is somewhat ironic in that they are promoting the card under a name with ties to gemstones (sapphires), which are also very much highly valued.

The Use of Plastic in Laptops

Another application of plastic is in laptops and tablets. Plastics are traditionally seen as cheap and shoddy, however, many more companies are now using plastics in the creation of the outer casings of laptops tablets. This is in the interest of the manufacturer because plastics are both easier and cheaper to manufacture. Switching over from metal to plastic is also in the interest of the consumer because plastics are much lighter than metals. These plastics are reinforced with fiber glasses or coated in aluminum to make them stronger and appear more attractive (as in less of a plastic look and more of a shiny, metallic, and glossy look). Many companies provide data which show that these plastics can be just as strong as metals.

Although the use of plastics in laptops and plastics may really be a win-win situation for both manufacturers and consumers (but perhaps not for the environment), there is a struggle to overcome the negative perception of plastics. Because of the social view of cheap plastic, many people still prefer the metal cased laptop, or metallic looking laptop, to the lighter and cheaper plastic laptop, even if these laptops all have the same durability. For example, Apple, among many other factors, is able to keep attracting a large consumer base to purchase their largely over priced laptops due to their sleek and attractive design using metal instead of plastic.



Conclusion

As the two examples of the usage of plastic in credit cards and laptops have shown, even though there is a technology developed to make plastic the more economically favorable material in many applications, the social influence on the material impacts its range and depth of impact. Because plastics are very low cost to make, products made with plastic are viewed in the negative way of being cheap. Also metals are relatively much more rare and costly than plastics, so they are more valued than plastics are. This is a very good illustration of how materials not only have physical properties, but also social properties. Therefore in material sciences, product development, and product advertising, there must be an awareness to the scientific affordances as well as an awareness to the social affordances of the material.

Hodder's Entanglement Theory states that humans depend on things, things depend on humans, and humans depend on things that depend on humans. The truth of this theory is apparent in the two examples with plastic. However, one aspect of these examples that is not covered in the Entanglement Theory but is important to note is the entanglement of things depending on other things. We see this relationship in the dependence of the Chase Sapphire Card and the link to gemstones to give the card greater value. These relationships show just how not only that humans are entangled with materials, but that materials are often also entangled with other materials.

Sources

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•PowerPoint: Week 11 Plastics by Dr. Jones

GLASS

Glass- an amorphous solid whose properties vary from weak to strong as steel, thicker than metal to thinner than hair, shattered spontaneously to bulletproof, red to gold to blue. Originally discovered in nature made from volcanic ash, the first ever use was for hunting. Humans have since discovered various ways to manipulate the properties to use to their advantage.

Efficiency is the goal of the century. We are always looking for ways for our things to go faster and to be universal, get more for less, have better quality. Innovators are looking for ways to manipulate old materials to get new functions from them, and to ultimately discover the material that fits the need of all things required for a specific task.

The possibilities with glass keeps growing. It has a tie with our lives: it is used to learn, for research, and to save our lives, and also in daily activities, where we physically handle it without thought as to what it truly provides for us.

Fiber Optical Lens Surgery is used for Endoscopes, making surgery quick and less painful

Windows and Lenses

Every building or human structure has a window. Glass windows let the light in because it is transparent, keep the cold out because it is an insulator, and protect us from the elements while keeping us connected to the outside. Stained glass is an art, featured often in cathedrals with beautiful religious images that refract the sun's light. Convex lens allow us to see things beyond the human eye.

Material & Historical

We know windows in our homes and workplaces as transparent and withstanding of the world outside. Insulating properties keep the heat in. Glass with impurities cause the glass to refract light and illuminate colors. Glorious stained glass was first crafted during the second century and bleached glass is now commonplace. Convex lenses magnify and are therefore used in telescopes and as correction lenses for eyesight.

Technological & Societal

Colored glass is enlightening and beautiful, a form of art. Humans are curious, but also value safety. Windows give us both. Microscopes and telescopes give us insight to different worlds and perspectives. Correction lenses enable all humans to have the opportunity to cure their curiosity. Windows and lenses withstand the elements, and allows a safe environment, not only in buildings, but in vehicles such as cars, boats, and even rockets. With glass, we can keep a connection with the world around us while remaining safely behind the glass. The only major concern is the seemingly spontaneous shattering when it falls.

Fiber Optic Cables

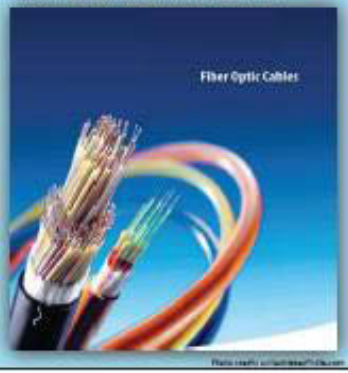
Glass fibers, or fiber optic cables, are now replacing copper wires for communicating more information at a monumentally faster speed. These fibers, thinner than a strand of hair, is a tube that refracts a laser beam that bounces off the walls throughout the cable to the other end, sending messages with the laser through binary coding.

Material & Historical

Small and therefore strong as steel, these cables are produced and used for their electric conductivity. With significantly less energy, these cables can transport data at ridiculous speeds. One fiber-optic cable was installed across the Atlantic Ocean in 1988 for long-distance communication, connecting New Jersey to the UK and France. The first form of telecommunication with fiber optic cables was with Alexander Bell with the first phone. Primitive compared to current times, revolutionary nonetheless.

Technological & Societal

Surgeries can be simple and quick, with the tiny fiber optic lens eliminating the size of the incision. Using fiber optic cables for information transmission is expensive and therefore primarily used for long-distances. Although not widespread, it is now being installed in communities by phone companies for speedier, better quality phone, television, and computer connections.



[redacted]

EMA1004
Group 8
11/22/13

This glass prism chandelier refracts the light and displays a rainbow of colors. Why does this happen? The bonds between the molecules of pure glass do not have excess, unpaired electrons. When impurities are added, unpaired electrons are being added, and the bond energy decreases. The difference between the energy of the bonds and the energy of the wavelength of light is what produces pretty colors.

Storage

Chemical and heat resistant, glass is utilized in kitchens and laboratories because of its sterility, durability, and high heat tolerance.

Societal

Glass blowing is an art form, and colored vessels are aesthetically pleasant. Crystalline forms of glass, such as prisms, are vibrant and expensive because of their purity and beauty. Containers are efficient when they can be moved directly from the oven to table to freezer, eliminating all of the middle men. Ease of cleaning is important in saving time and energy. Sterility gives us comfort in using glass in regards to food, there is little chance in consuming something harmful that you could have avoided by simply cleaning the container.

Technological & Material

Glass containers are chemically resistant and therefore sterile and easy to clean. They do not absorb odors, unlike ceramic and clay vessels. Soda-lime glass is malleable, reasonably strong, cheap, and easily produced. It has a general use of storage and mild cooking. Borosilicate glass can withstand higher temperatures and sudden temperature changes. Therefore, it is used in the kitchen to cook and can be stored in the freezer right away. It is also used in lab equipment.

Historical

First used as a container in the fourth millennium BCE as glaze on clay pots. It was not utilized by the common people until vessels were mass produced economically with the invention of glass-blowing.

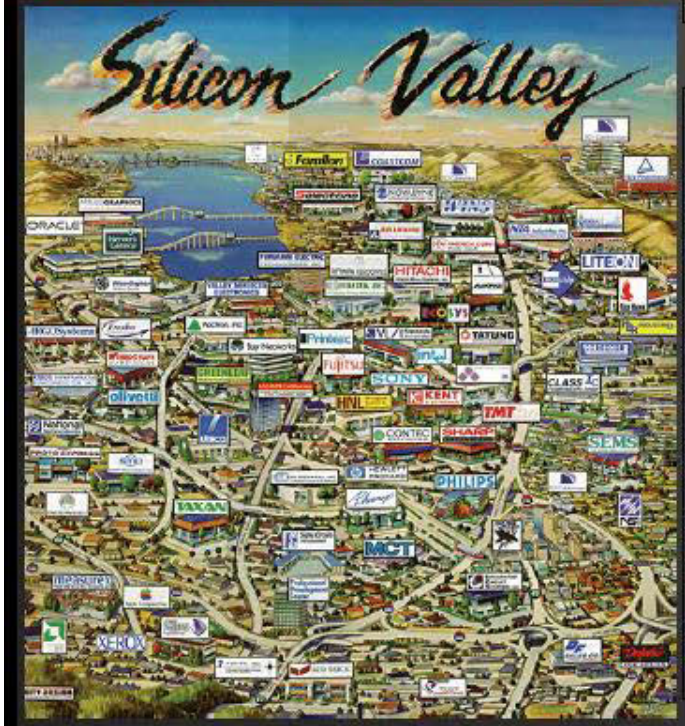
Silicon

What is the general abundance of the material?

The image to the left, represents the endless possibilities that silicon has to offer to the world. Silicon which is processed through sand, something that is sometimes taken for granted, is incredibly abundant. Thus the image exemplifies the endless possibilities that can come through silicon production. Moores law states that the number of transitors on circuits doubles every 2 years.

Silicon is 7th most abundant element in the universe, and 2nd on earth. Since it is so abundant, silicon powers things in our daily life such as video games, the internet, texting etc. It is the fundamental element behind running all of these things, thus its significance is crucial.

Source: www./-vTqc1hdqo2o/UIA2ZipLcYI/AAAAAAAABw0/3rho6mq-YLE/s400/ws_Sand_dunes_1600x1200.jpg



In which realms of society did the materials development have an impact?

Silicon has also shaped an entire industry as well as the lifestyles of everyone revolving around silicon. Silicon Valley, which is located in the southern region of San Francisco, is an area in which there are hundreds of industries which revolve around the production and manufacturing of silicon.

Pictured on the left is a rough image that displays where modern technology is advancing. Silicon Valley is the home of many billion dollar companies such as Apple, Google, Oracle, etc. A common belief is that there is a limit to Moore's law of transistors, however billions of dollars go into companies in Silicon Valley in order to enhance technology and allow for further improvements in our everyday life.

The transistor is considered by many as the fundamental building block of the information age. It allows for the recording of information in computers, calculators, and radios.

Source: http://1.bp.blogspot.comhttp://cdn.techinasia.com/wp-content/uploads/2013/09/silicon-valley-asia.jpg

At what time did the material become enabling?

Silicon, an element discovered in 1823, has had an enormous impact on modern technology. It makes up roughly 27.7% of Earth's crust, making it very abundant. Silicon has a very high melting point, 1414°C, allowing for many applications such as transitors. It is produced by heating sand with carbon to temperatures exceeding 2200°C.

What technology did the material enable?
What people groups were involved at the time of first use?

Perhaps one of the most important impacts that silicon has had in the world is the fact that it has given so many possibilities to learning and education. And so that is the reason of the third and final photo below. Through the use of computers and calculators, all of which are powered through the use of silicon, the entire world has benefitted greatly as we are now capable of sharing information across the globe in a matter of seconds. Silicon is the building block of the modern spread of information throughout the globe.

This allows for a smarter, more informed community through things such as YouTube, Wikipedia, Wikileaks, Twitter, Facebook, and even weather forecasting. Clearly, the impact of silicon in our society is like no other element. It has allowed for the spread of not only information but curiosity, what I mean by this is that it has had the power to spark an innate trait to learn and better the community by doing simple things such as exposing a teenager in a third world country to computer programming.

Source: http://mashcdn.com/media/ZgkyMDEyLzEyLzA0L2ZjL2hvd3N0dWRlbnRzLmFYVi5qcGcKcAl0aHVtYgk5NTB4NTM0IwplCWpwZw/dbba3b87/a77/how-students-use-technology-infographic--c84d534271.jpg

By definition, technology is anything that simplifies a previous method. I see no other word to better describe everything that the production and manufactoring of silicon has done to the world. It is through elements such as silicon, bronze, glass and many others that we really see first hand the impact of materials science on the human race and all of or daily interactions. Additionally, it is imperative for us to realize not only the impact that silicon has had in society but also how society has shaped the production, manufacturing, and use of silicon to fit into our standards and needs.

[redacted] – EMA1004
Materials Impact on Society

Paper

By: [redacted]

Paper is made from cellulose (mainly wood). Cellulous is held together by lignin, which chemically binds cellulous together. Lignin is very hydrophobic and two special processes are done to sever cellulous and lignin. These two process are mechanical and chemical pulping. Mechanical pulping involves wood to be boiled and ground between stones. This method has a higher yield, is cheaper, and causes less pollution. Chemical pulping uses sodium sulfide to break down the lignin and cellulose. This process makes more durable paper.

Wood chips being boiled and ground for mechanical pulping.
http://www.lothlorien.co.za/paper_mill/paper_making_process.html, 24 Nov 13

My personal shelf of books. 24 Nov 13

1. What is the general abundance of the material?
Paper is very easily made and as a result, is very cheap. The abundance of wood and other materials that are used to make paper, make it easy to produce and easily acquired. I can buy as much paper as I want and it won't break the bank. Its abundance also enables so much more than just easily communicating with one another but also can serve as a means of entertainment.

2. What people groups were involved in the start of its use?
Originally, the Chinese were the first to make paper in the 3rd century. Other regions also developed their own type of paper based on the materials accessible to them. The Egyptians had papyrus and the Europeans had parchment, each with their own advantages and disadvantages. Over time we can see people developed different techniques for making paper to meet their needs. For me, I have very durable lightweight pieces of paper to make my books long lasting.

3. What technology did the material enable?
Paper became the medium for sharing ideas. Since sharing ideas became so important, the printing press was invented to make it faster to spread knowledge. Without paper, printers would not exist. Most households have a printer, including my own.

4. In which realms of society did the material's development have an impact?
Paper had and has the ability to impact all parts of society because of its ability to share information. The biggest impact for me however, is in the educational realm of society. Paper allows me to read and learn about various cultures as an anthropology major. 90% of my classes are heavy on reading and writing. Paper is the perfect medium for me to do these things. If I had to carry around a clay tablet just to take a few notes, being a student would be very difficult

This is the "modern" version of paper: my laptop and Kindle. 24 Nov 13

1. What is the unique enabling properties of this material?
If abundance was ever an issue, it has been solved through the use of electronic sheets of paper. The unique property here is I can store thousands and thousands of sheets of paper in a very small confined space where its protected from weathering and things of that nature.

2. What events lead to the development of "electronic" paper?
The invention of computers and more importantly, the development of home computers has allowed for every person to write electronically and read electronically. This development has enabled me to do things like take notes in a very quick and organized way.

3. What role did the material play in the technology?
Historically, paper developed from rolled up scrolls, to hand transcribed bound books, to modern day Kindles. The need to write things down allowed engineers to expand the horizons beyond just a white 9 X 11 inch rectangle. Today I can read off my Kindle, take notes with my iPad and so much more because of the initial need to write things down.

4. How has this material impacted communication between people?
Paper has made it easy to communicate with people and electronic paper has made it all the more easier. I can send messages online in electronic letters and can easily communicate with anyone in the world. This ability has enabled us to connect with millions of people but then again none at the same time if we do not want to. This allows things like globalization to happen very easily.

Concluding thoughts...

The impact of paper on my own life and life today is difficult to confine to a single paragraph. I could attempt to draw out an entanglement diagram but that would take too much time. Instead, acknowledging the tangible and personal affects is easier to point out. Having durable and easily producible books allows me and other students to learn, communicate our own ideas, and save those ideas in an easy way. With out paper, the world would not have had a medium to be able to do these things. As this need continues to exist, this fuels the reason to engineer new and innovative technologies that will act as tools to better our future. The drive to develop new materials that can store a nearly infinite amount of information on new "forms of paper" will continue to shape and change societies all over the world.

[redacted]
Dr. Kevin Jones

Aluminum

This is a picture of an aluminum ingot. It was found at Wikipedia.com

Impact paradigm questions

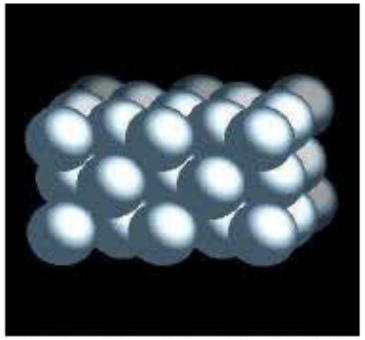
1. What are the unique (enabling) properties of this material?
2. What people/groups were involved at the time of its first use?
3. What technology did this enable?
4. What were the financial implications of the new development?

Aluminum's most enabling property is that it is very lightweight. Many car parts are made of it because it reduces deadweight and energy consumption while increasing load capacity. Due to aluminum being the most abundant metal in Earth's crust it has the very unique and enabling property of being cheap. When the properties of lightweight and cheap are combined the possibilities for its use are endless.

Pure aluminum alone does not enable many technologies. However, after it goes through the process of solid solution hardening it becomes a very enabling metal. Its applications span from car parts and airplanes to soda cans and aluminum foil.

Although aluminum was discovered before them, Hall and Heroult simultaneously came up with the process of extracting aluminum from other compounds in a cheap manner. They did this by passing an electric current through a non-metallic conductor to separate the conductive aluminum. With this work they were able to take the price from $1200 per kilogram to 18 cents a pound. This prompted Hall to start the Pittsburgh Reduction Company which we know today as ALCOA.

The financial implications of aluminum go beyond it having the ability to be produced cheaply. It can also be recycled without downgrading any of its properties. It is recycled at 5% of the energy cost of extracting it from compounds which drives the price down even more.



Chemically, physically and mechanically aluminum is very similar to steel, brass and other metals. It has the ability to be formed, machined, cast and melted. Aluminum is also an excellent conductor of heat and electricity. In relation to its weight it is almost twice as good of a conductor as copper which is why it is the most commonly used material for power transmission lines. Aluminum weighs about one third that of steel making it perfect for applications such as cars and aircraft. Aluminum is a very corrosion-resistant metal. It naturally forms a protective oxide coating which helps fight further oxidation. The ductility of aluminum plays a major role in its uses. Its ductility allows aluminum to be formed close to the end of a products design. Aluminum is also odorless and impermeable. This is why it foil is made from aluminum, because it lets not odor or taste out while also not being toxic itself. The key property for aluminum is that it is 100% recyclable and when recycled about 95% of energy is conserved compared to extracting new aluminum. Aluminum is also the most abundant metal in Earth's crust although it is rarely found in pure form because it is so reactive.

Aluminum is the 13th element on the periodic table. It has a crystalline structure which interlocks when cooled from a molten stage. Each crystal is isotropic and although the crystals randomly arrange the atoms within them align making the entire metal isotropic. Despite its regular lattice structure gaps often form between atoms. These gaps can cause fractures which is why aluminum alloys are always used instead of pure aluminum.

ALCOA

Returning to "Human-Thing Entanglement" we see how as a society we are completely intertwined with not only aluminum but all materials. Just as the Romans relied on concrete to make magnificent structures and Louis relied on gold and diamonds to show his prestige; our society relies on rare earth elements for our electronic s and steel for our buildings among countless other materials. Our only problem with this extreme entanglement is that of our ability to be in control of materials and technology and not let them control us. It seems that often times we rely more on our technology than we do ourselves which could have potential catastrophic consequences in the future.

This is a picture of an aluminum can, one of the most recycled materials on Earth. This image was found at depositphotos.com

Impact paradigm questions

1. What is the source of the material?
2. What events limited the impact of the material prior to or following its development/ discovery?
3. What are the limits to the technology?
4. To what extent will materials processing play a role in future impact?

Aluminum is rarely found in a pure form in nature and for this reason , all aluminum must be extracted from compounds which contain it. The greatest part about aluminum is how efficiently it can be recycled. This helps its future impact because it will still be around but will not be detrimental to the environment. This plays a huge role in my life with it because I am very "in" to recycling and it is very important to me. German car manufacturer BMW is said to make more energy efficient cars than the Toyota Prius because they use 100% recycled aluminum. This cuts 95% of the energy cost in production so it would make since that all of our cars will be made from aluminum in the future.

Prior to the Hall-Heroult process of extracting aluminum it was limited due to being too expensive to produce. It was not until there was a way to have cheap electricity that aluminum could be produced at such a low cost. Before this it was worth as much as gold and Louis actually served his guest on aluminum plates because it was so rare.

There are almost no limits to the uses of aluminum, especially its alloys. These alloys (which are usually a compound of copper or silicon) are as strong as steel but half the weight giving it twice the specific strength. Aluminum also has the ability to be molded into any shape which is why it can be used in any industrial setting.

Clay

What are the enabling properties of the material?

Clay is very abundant and for that reason can be used in many things. Its relative abundance also translates to its cost, which is low and also lends the material to widespread usage. Because clay is very small particles suspended in water it is also available to almost everyone versus other materials that have cost and or geographical constraints. Clay has a very high plasticity when mixed with water which can lead to many applications. The unique property of clay is that it can be heated and transformed into a ceramic. Ceramics are impervious to water which is an important property if it is used in functional pieces. Also the insulator and porous properties lead to clay being able to absorb. Lastly clay can become very brittle once it has been fired.

What other processes does the material enable (how is the material entangled) ?

Because of clays many properties it is a very important material in processing, manufacturing and waste reduction. In industrial processing clay is used to make paper and cement. Two very important products that we have also talked about this year. The impermeability of clay to water may be one of its most important properties because it enables the usage of clay in the natural sealing. Theses seals are important to dams and also to the protection of the ground from landfill seepage. Lastly, clay has a relatively high absorption due to its porous structure. This helps clay be entangled to many processes that society depends heavily on, such as the removal of heavy metals from water and the purification of air. Without the use of clay in these applications society would be impacted heavily, especially in the area of pollution.

To what extent is processing a part of the materials impact?

Clay as a material is a fine-grained soil suspended in water due to how small the particles are. When mixed with water these particles form clay and from there it can be used in many different things, i.e. building, medicinal practice and cooking. However most times it must be fired to create a tough structure that is impervious to water. The creation of things with clay is very personal to me in the way that it is used in ceramics. I have been throwing and hand building pottery for over two years. The processing of clay comes into effect in the way I work with it. Without a potter a piece of clay will never become a functional piece or even an artistic piece. The clay uses me to become something that can be functional, I spend time and energy transforming clay into shapes that are useable and then firing the clay. In return I use the clay to create pieces that myself and others can use, pieces that are artwork and also to relax.

To what extent is our relationship with the material?

Ceramic pieces are often functional ware. We use then to cook, to eat off of and to drink out off. We all must eat and our dependence on dining ware such as plates, cups and bowls is evident in our society. Because clay is the main materials in such utensils we depend heavily on it and since eating is such an essential part of everyday life we are entangled with clay in a very important way. Even when we are not eating off of ceramic ware, it is often used in cook ware such as Dutch ovens or in nonstick pans. Dating back to the civilization of Çatalhöyük clay balls were used in cooking to heat food.

Poster By: [redacted]