RESEARCH MATERIALS INNOVATION GROWTH



DEFENSE

The development of advanced materials for stealth technology increases our national security and provides a tangible economic impact with new jobs and new industries in areas such as advanced engines and metamaterials.



ELECTRONICS

Microprocessors have emerged from basic materials research to provide smaller and faster components for computers, cell phones, and other electronics industries.



RENEWABLE ENERGY

Alternative technologies in various stages of research and development hold promise for societal and economic impact that is not yet quantified. Solar and wind conversion are two such examples.

Return on Investment

While it may be difficult to assign a universal "return on investment" for broad scientific research, and specifically for materials research, there is a direct correlation between science, materials and the economy. Specifically, investment in scientific research is the starting point for economic development. Modern computing, manufacturing systems and societal infrastructures (examples on left) have all had a dramatic impact on today's economy, and all are built on scientific advancements and innovation.

At present, economics scholars offer the best insight into the impact of science on the economy:

- From 1948-2007, 58% of growth in manufacturing output is attributable to R&D. C. Hulten, "Growth Accounting," *Handbook of the Economics of Innovation*, vol. 2, pp. 987-1031 (2010)
- For every ½% of GDP investment in R&D, a nation's GDP increases by 9.5%. T. Bayoumia, D.T. Coe, and E. Helpman, "R&D spillovers and global growth," *Journal of International Economics*, vol. 47, pp. 399-498 (1999)
- 34% of economic growth can be traced to 'growth in knowledge'.
 E.F. Denison, "The Sources of Economic Growth in the United States and the Alternatives before Us," *The Economic Journal*, vol. 72, pp. 935-938 (1962)

Case Studies

Case studies also provide valuable insight on the "return on investment" for materials research.

- The 'Benefit to Cost Ratio' for Materials Research is 11:1.

 A.C. Sciarretta, et al., A Methodology for Assessing the Military

 Benefits of Science and Technology Investments, 2008.
- Every dollar invested in chemical research (including materials) gives back \$40 to the economy.
 P. Thomas, M.B. Albert, D. Hicks, and P. Kroll, *The Council for Chemical Research*, 2005.
- The 'Benefit to Cost Ratio' for Ceramic Phase Equilibria research is 10:1.
 - G. Tassey, Evaluation and Program Planning, 1999.



A Success Story

Since it was patented in 1996, Ames Laboratory's lead-free solder has been licensed by more than 50 companies worldwide—generating nearly \$39M in royalties, based on over \$2.5B in global sales. This work began as basic research funded by the Department of Energy's Office of Science and Office of Environmental Management.



*******RESEARCH******MATERIALS INNOVATION****ECONOMIC GROWTH

