

Connecting the Dots: Creating a Southern Nanotechnology Network

SOUTHERN GROWTH POLICIES BOARD

Southern Technology Council

Charity Pennock

Scott Doron

GEORGIA INSTITUTE OF TECHNOLOGY

Science, Technology & Innovation Program

Dr. Jan Youtie

Dr. Philip Shapira

Ajay Bhaskarabhatla

Erin Lamos

Uttam Malani

John Slanina

Alexa Stephens

Li Tang



*This report was generously funded by the Technology Transfer and
Economic Development Directorate of the Oak Ridge National Laboratory.*

TABLE OF CONTENTS

5	Executive Summary
8	Nanotechnology: An Overview
12	Nanotechnology in the South
14	I. Knowledge Generation
29	II. Human Capital
45	III. Research and Development Funding
57	IV. Patenting
65	V. Commercialization
72	Appendix I Definition of Nanotechnology
74	Appendix II Broad Thematic Keywords
75	Appendix III Prize Names with Reference to Nanotechnology
77	End Notes
78	Acknowledgements

Executive Summary

TWENTY YEARS AFTER THE ATOMIC FORCE MICROSCOPE made atoms visible, the field of nanotechnology is emerging out of the laboratory and into the marketplace. With scientists now able to see and manipulate material at the nanometer level, the doors have opened for increasingly durable materials, non-invasive medical procedures and faster semiconductors. These events present a rare opportunity for the South to become a major participant in the emerging nanotechnology industry. With other regions and nations relentlessly pursuing nanotechnology initiatives, the window of opportunity for the South to assume a leadership role in the nanotechnology industry is small, meaning the South must aggressively move forward and it must move now.

In general, the South's strengths in nanotechnology will surprise many, but its weaknesses are undeniable with the region consistently lagging behind the nation in annual growth in almost all categories. This report provides data to illustrate the South's strengths and weaknesses in the areas of human capital, knowledge generation, patents, funding and commercialization. It will guide the region's steps in connecting the dots for establishing the South as a leader in the nanotechnology field.

Connecting the Dots: Creating a Southern Nanotechnology Network was researched and written by the Southern Technology Council, the advisory council on innovation and technology policy issues for Southern Growth Policies Board, and the Georgia Institute of Technology. Southern Growth Policies board is a regional public-private partnership devoted to strengthening the South's economy and supported by 14 Southern States—Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Virginia, West Virginia and the Commonwealth of Puerto Rico. The Southern Growth region cited in the report refers to these 14 states.

Nanotechnology in the South

BETWEEN 15-20 PERCENT of all U.S. nanotechnology research activity occurs in the Southern Growth region with every Southern Growth state publishing nanotechnology articles, producing nanotechnology dissertations and winning nanotechnology grants.

THE SOUTHERN GROWTH REGION contains national and global leaders in nanotechnology research such as universities in Georgia, North Carolina and Virginia and at Oak Ridge National Laboratory (ORNL) in Tennessee.

THE REGION'S INDUSTRY SEGMENTS largely reflect the U.S. distribution, with the Southern Growth region being slightly stronger in materials and biology.

NANOTECHNOLOGY COMPANIES cite the abundance of talent and overall quality of life as major assets of the region and lack of venture capital and national recognition as weaknesses.

Regional Strengths

The Southern Growth region's researchers claim:

- Twenty percent of all nanotechnology research publications in the U.S.
- Nearly 20 percent of all highly cited nanotechnology researchers in the U.S.
- Ten percent of all nanotechnology journals editors in the U.S.
- Fifteen percent of all nanotechnology doctoral dissertations in the U.S.
- A higher growth rate for patented inventions than the U.S.

The Southern Growth region's research institutions are characterized by:

- Four of the top 25 national nanotechnology institutions.
- Twenty percent of the top 100 national nanotechnology institutions.
- Clusters of at least three or more first authors of nanotechnology publications in every state.
- Strong linkages between the South's research universities and ORNL.
- Strong linkages between the South's research institutions and China, Russia, Germany and Greece.

The Southern Growth region's nanotechnology funding includes:

- Twenty percent of the National Science Foundation's (NSF) nanotechnology funds.
- At least two institutions from every Southern Growth state receiving NSF nanotechnology funding.

Regional Weaknesses

OVER THE LAST TEN YEARS, the Southern Growth region's annual growth in the selected nanotechnology indicators has lagged behind the nation's, especially in the areas of commercialization funding and patents.

THE REGION'S INSTITUTIONS lack strong linkages to critical U.S. centers in California and the Northeast.

THE REGION IS SIGNIFICANTLY WEAK in patents with only 14.8 nanotechnology patents per million in the Southern Growth region compared with 40.9 for the nation. In addition, a large proportion of the South's patents are assigned to organizations outside the region.

ALTHOUGH THE REGION RECEIVED more than 15 percent of the national Small Business Innovation Research (SBIR) investments, more than half came from the state of Virginia alone.

Recommendations

As the South seeks to increase its share of nanotechnology activity nationally and internationally, the region needs to take specific steps in achieving a leadership role. Below are recommendations for increasing the South's share of nanotechnology activity with a focus on improved collaborations and increasing the number and growth of nanotechnology companies.



Establish the Southern Nanotechnology Network, a membership network to increase the awareness of the industry among the South's citizens, governments and businesses. The Network will:

- Offer opportunities for collaborative interaction between the public and private sectors including state and federal legislators and serve as state advocates for nanotechnology research and the industry.
- Identify policy advocates in each Southern Growth state to place the advancement of nanotechnology as one of its primary economic development goals.
- Develop and execute a branding strategy for Southern nanotechnology to promote the South's assets within the region, nationally and internationally.
- Coordinate collaborative trips to California, New York and Massachusetts to promote linkages between the region and other major U.S. centers.



Establish a Southern Nanotechnology Institute in the Southern Growth region, based on the resources of Oak Ridge National Laboratory and other assets. The role of the institute will include the following:

- Creating research coalitions to investigate targeted nanotechnology segments.
- Serving as a magnet for federal, state and corporate investments.
- Creating an interactive web portal cataloging research and commercialization activities in the region.
- Developing ideas and guidelines for nanotechnology education in pre-K–20.
- Developing nanotechnology business incubation capacity for all Southern states.



Increase funding opportunities for Southern institutions

- Provide state matching funds for SBIR and other federal grants with specific focus on supporting initiatives that create stronger linkages with leading national and international research centers.
- States will support the development of equity funds for nanotechnology companies.



Enhance the availability and affordability of research tools

- Develop a survey of nano-equipment in the South of the region's universities and research labs, so that other users may gain access to these assets and subsidize their expenses through user agreements.



Other considerations

- More in-depth look at commercialization including the development process, the South's market niches and the role of various funding sources.
- Research and analyze the issue surrounding the South's relative lack of patenting.
- Explore the opportunity and need for equipment cooperatives with vendors.