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NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Smith Woosley

Nanoengineering

Processing and Characterization of Functionally Modified Composites for Fused Deposition Modeling 3D Printing

Major Professor: Dr. Shyam Aravamudhan

Material		Weight Percentage	Functionality	
Polymer	Additive			
ABS	Carbon Black	20	Electrical Conductivity	$10^3\,\Omega$ Conductor
	Nickel	20	Magnetism	11.5 emu/g
	Graphite / Carbon Black	18/18	Electrochemical Energy Storage	26 mAh/g
	Iron	20	Bacterial Resistance	120 ppm iron surface, enhanced bacterial resistance
	Boron Nitride	20	Radiation Shielding	72% Shielding
	Gadolinium	10		90% Shielding

RESEARCH QUESTIONS / PROBLEMS:

- Fused deposition modeling (FDM) 3D printing is a promising additive manufacturing technique, but is currently restricted in application due to a limited choice of functional materials.

METHODS:

- Thermoplastic polymers were modified with functional additives to create FDM composites with useful characteristics.

RESULTS / FINDINGS:

- Five new materials with functional properties were successfully fabricated and demonstrated useful characteristics: electrical conductivity, magnetism, energy storage, bacterial resistance, and radiation shielding.

SIGNIFICANCE / IMPLICATIONS:

- With new functional FDM materials, the additive manufacturing technique can move beyond non-functional printing to production of complete end-use systems.