In the lab of Prof. Rosario Gerhardt, research focuses on the relationships between microstructure and the physical properties of materials and their relationship to processing. There are currently 4 graduate students working on a diverse set of projects which cover the entire materials spectrum (metals, ceramics, polymers, semiconductors, nanomaterials and composites). These projects are for the most part, unified by the common themes of electrical properties and composite materials, Dr. Gerhardt's areas of expertise. Still, the diversity of research topics in the lab provides an environment which encourages graduate students to be well-rounded while still becoming experts in their own particular research area. Many of these projects stem from collaborations with national labs and industry. Graduate students also have access to a wide array of experimental equipment including an atomic force microscope, multiple ac electrical characterization equipment and fixtures as well as optical and thermal analysis equipment.

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**Primary Characterization Techniques Used**

- 4-probe resistivity
- Dielectric properties and ac conductivity
- Impedance spectroscopy
- UV, Visible and IR spectroscopy
- SEM, TEM, AFM, optical microscopy
- X-ray and neutron scattering methods
- COMSOL Multiphysics simulations

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**Introduction**

Overall Research Theme

Structure-Property-Processing Relationships in All Classes of Materials

Rosario A. Gerhardt

Goizueta Foundation Faculty Chair and Professor

School of Materials Science and Engineering

Georgia Institute of Technology

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**ITO thin Film Results**

A custom-made sol-gel ITO ink was used to fabricate ITO films by spin coating under different humidity conditions. Figure 1. (a) Optical transmittance and (b) sheet resistance of ITO films as a function of the ambient humidity.

The sol-gel ITO film was used to fabricate ITO films by inkjet printing method. After annealing process, the ITO films show good combination of electrical properties, optical properties and surface morphology. These ITO films were used to demonstrate the formation of liquid crystal display (LCD) devices that shift in contrast when a DC voltage is applied.

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**Recent Graduates**: Thomas Rudzik, Tim Pruyn, Youngho Jin, Anna Janoff, Rachel Muhlbauer, Justin Brandt and Ning Xia

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**Fall 2020 research group**

Because of Covid-19 pandemic we had to conduct group meetings remotely via BlueJeans

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**Primary processing methods used**

- Nanoparticle synthesis
- Film formation
  - layer-by-layer assembly
  - spin coating
  - vacuum filtration
- New chemical compositions via chemical coprecipitation and mechanical mixing
- Polymer matrix and ceramic matrix composites using:
  - hot pressing
  - sintering
  - spark plasma sintering
  - 3D printing

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**Collaborators**: Valeria Lauter, Ken Littrell (Oak Ridge National Lab), Elliott Fowler, Mike Lilly, John Wall (Sandia National Labs), Jan Ilavsky (Argonne), C. Barry Carter (U. Conn.)