Fabrication of piezoelectric substrate for sensing applications

Laboratory Name: Stoeber Lab

Faculty Supervisor: Prof. Boris Stoeber

Postdoctoral Mentor: Kanagasubbulakshmi Sankaralingam

General Area of Research

Piezoelectric sensors, Nanomaterials, Material fabrication, Material characterization

Background of Research

Significant research efforts have been recently devoted to developing flexible piezoelectric material using paper as a substrate. Piezoelectric materials such as $BaTiO_3$ (BTO), ZnO, $ZnSnO_3$, Pb (Zr, Ti) O_3 – PZT, were demonstrated for its significant performance in various technological applications, such as remote/wireless data transmission, battery charging, the powering of electronic devices and sensing applications.

Among the other materials, BTO has been regarded as one of the most technologically promising materials because of its strong piezoelectric properties and the environmental advantages that it offers over lead based PFO ceramics such as PZT. However, little experimental consensus exists on the fabrication of flexible piezoelectric substrates at which the size-dependent properties of the BTO is suppressed. Hereby, we are developing the piezoelectric substrate by using various fabrication approaches without affecting its piezoelectric coefficient in particularly for sensor applications.

In addition to the control of chemical compositions, the control of microstructures such as domain configuration, grain orientation, and grain size, is also important to enhance the piezoelectric properties of lead-free materials. Recently, some researchers have reported the grain size dependence of piezoelectric properties of $BaTiO_3$ ceramics, in which the piezoelectric strain constant increases with decreasing grain size. For the development of next-generation lead-free piezoelectric materials, it is necessary to understand the grain size effect on the piezoelectric properties of $BaTiO_3$.

Also, the piezoelectric strain constant, the piezoelectric voltage constant, the electromechanical coupling factor, the elastic compliance and the free permittivity are well interrelated and influence the piezoelectric strain constant. This project will be focused on fabrication of piezoelectric substrate and evaluating the above mentioned properties by a resonance–antiresonance method with IEEE standards using the impedance analyzer for flexible sensor applications.

Tasks to be performed by student

- To fabricate and characterize the piezoelectric substrates
- To test the piezoelectric performance by impedance analyzer

Facilities and Team

The student will have access to an office space in Kaiser and working space at AMPEL-146 for the experimental works. The student will work closely with Prof. Boris Stoeber's post-doctoral fellow, Kanagasubbulakshmi Sankaralingam (email: ksankara@mail.ubc.ca).

Supervision Received

The student will be assisted on a regular basis by the postdoctoral mentor and will receive guidance from Prof. Stoeber. The student will be provided with initial references for literature review, and background related to the overall project.