

CBC SEMINAR ANNOUNCEMENT



Professor Taras Kolodiazhnyi
National Institute of Materials Science, Japan

Metal-insulator transition in Ti-based perovskites

In 1949 Mott first introduced the idea of the abrupt insulator-to-metal transition in the host material when the concentration of the charge carriers furnished by donor impurities exceeds a critical concentration n_c . Since then the universality of this criterion has been proven over the range of 10^9 in critical concentration and over 600 Å in effective Bohr radii. Stoichiometric $ATiO_3$ perovskites where $A=Ba, Ca, Eu, Sr$ are band gap insulators. Charge carriers (and consequently conductivity) can be introduced in these perovskites by doping for example, with oxygen vacancies. Several recent studies [e.g., K.Szot *et al.*, *Phys. Rev. Lett.* **88**, 075508 (2002)] have shown evidence of partial clustering of the O vacancies as well as possible segregation of oxygen vacancies at the extended one-dimensional defects in the $SrTiO_{3-x}$. Based on these novel findings it has been argued that electronic transport properties of $SrTiO_{3-x}$ are mainly controlled by these extended defects; and that the whole point defect chemistry and superconductivity in $SrTiO_{3-x}$ have to be revised. In this contribution I will show that there is no urgent need for such a drastic revision because the Mott criterion of the insulator-to-metal transition holds fairly well for n-type $SrTiO_3$, $BaTiO_3$, $EuTiO_3$ and $CaTiO_3$; especially when we take into account that the n_c differs in these materials by more than three orders of magnitude. I will also compare electronic and magnetic properties of these compounds as revealed by the low-temperature specific heat, Seebeck and Hall coefficients, magnetic susceptibility, and optical data. Moreover, I will show that the polar lattice distortions partially survive in the metallic phase of $BaTiO_3$ providing support for "ferroelectric metal" concept introduced by P.W. Anderson in 1965 [P.W. Anderson and E. I. Blount, *Phys. Rev. Lett.* **14**, 217 (1965)].

| | |
|---------------|-----------------------------------------------------------|
| Date: | 25th October 2012 (Thursday) |
| Time: | 12:00pm – 1:00pm |
| Venue: | NTU SPMS CBC Building Level 2, Conference Room |
| Host: | Asst Professor Martin Pumera |