

# Colloquium Cukrovarnická

**ve pátek dne 10. září 2010 v 14:00 hod.  
ve Fyzikálním ústavu Cukrovarnická v seminární  
místnosti (budova A, 1. patro)**

## Single Crystal Diamond Electronic Devices



**Dr. Daisuke Takeuchi**

*National Institute of Advanced Industrial Science & Technology (AIST), Tsukuba, Japan*

Diamond has attracted a lot of researchers as an ultimate semiconductor material because of its superior physical and chemical properties. Specially, its large band-gap of 5.47 eV, the highest thermal conductivity at room temperature, and high carrier mobility enable to design superior power devices. However, phosphorous donor (560 meV) and boron acceptor levels (360 meV) in diamond are quite deep due to its low dielectric constant and relatively heavy effective mass of carriers in diamond rather than those of conventional semiconductor materials. Some groups attempt to use diamond Schottky diodes as high-temperature devices, but the gain seems not to be so high compared to other wide-band-gap semiconductors such as SiC and GaN.

Thus, due to these problems, we attempt to establish new concepts for diamond electronic devices that are based on new device physics employing unique physical properties of diamond: (1) high-density impurity conduction at room temperature, (2) stable excitons (80 meV) even at room temperature, (3) negative electron affinity (NEA), (4) surface conductive layer, and (5) long spin-lattice relaxation time. In this talk, we introduce our experimental results on the state-of-the-art diamond devices using these unique properties (1, 2, 3) of diamond. We successfully demonstrate diamond ultraviolet-light emission device (UV-LED) even though it is an indirect band-gap material, electron emitter with p-n junction diode, and develop a new power device, which can overcome the basic problems of diamond electronic devices. These results give a lot of chances to access unreachable region for the conventional semiconductor materials in trade-off relationship between on-resistance and break-down voltage of power devices, where diamond can play an important role for future energy technology.