Seminář odd. 26
Tenkých vrstev a nanostruktur

Fyzikální ústav AVČR, Cukrovarnická 10, Praha 6

datum: 9. 10. 2014 čtvrtek
čas: 10:00
místnost: knihovna, budova A, 1.p.

TÉMA

Diamond Field Effect Transistors with high-k gate insulator

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Diamond has an attractive interest as one of next-generation power electronics materials. Since the sheet hole density in the hydrogenated-diamond surface was reported to be as high as 1E14 cm-2 which was one or two orders larger than other semiconductors. Therefore, we should use such the big advantage and then have to develop the high-k gate dielectric for diamond in order to control the high-density hole carrier. Since the high-k dielectric provides the large capacitance at a given gate voltage, the controllable carrier density is predicted to be increased with increasing the dielectric constant. For this purpose, as a first step to search the best high-k insulator material to the diamond, we have demonstrated the diamond FETs with high-k LaAlO3/Al2O3 and HfO2/HfO2 stack gates prepared by a combination of sputter-deposition (SD) and ALD techniques. Since the FET property is sensitive to the interfacial states between the diamond and dielectric and the border traps in the dielectrics, it is essential to obtain the guideline for developing the excellent gate dielectric for diamond.

In this talk, we will show why the high-k dielectric insulator is required for diamond and demonstrate the LaAlO3, HfO2, and Ta2O5 as the gate insulator of the FETs using the hydrogenated diamond p-type channel. In addition, to understand the interface property between the diamond and dielectric, we will investigate the electric properties of interface between the H-diamond and insulator.

odborný garant: *doc. RNDr. Bohuslav Rezek, Ph.D.*