Low-Temperature Deposition of Diamond Films by Microwave Plasma CVD in $CH_4/CO_2/H_2$

Yonhua Tzeng[1,2], Stephen Guu[2], Yu-Sen Cian[1], Fu-Cheng Lin[1], Alen Jhang[1], and Shang-Ho Wang[1]

[1]*Institute of Microelectronics, College of EECS, National Cheng Kung University, One University Rd, Tainan, Taiwan*

[2]*Academy of Innovative Semiconductor and Sustainable Manufacturing, National Cheng Kung University, One University Rd, Tainan, Taiwan*

tzengyo@mail.ncku.edu.tw

Diamond films of tens to few hundreds of nanometers in thickness with excellent dielectric, thermal, and mechanical properties are desirable for modern semiconductor applications. Low temperature deposition is required to be compatible with prior fabrication processes within an allowed thermal budget. For silicon integrated circuits, the diamond deposition temperature is usually limited to 450℃or lower. However, the growth rate of common diamond CVD processes decreases with decreasing substrate temperature rapidly. On the other hand, the thermal conductivity of polycrystalline CVD diamond films decreases rapidly with decreasing grain sizes, which are typically less than the film thickness. Graphitic contents in the grain boundaries add to the leakage current of a CVD diamond thin film.

We are devoted to the search for promising strategies and methods of fabricating CVD diamond nano-films on silicon by plasma CVD in CH4/CO2/H2 at temperature of 450℃or below. Thermal conductivity of diamond films are measured to correlate with nanostructure, Raman scattering properties, and the seeding/nucleation and CVD conditions. Diamond films of 100-200 nm thick exhibiting thermal conductivity of greatly exceeding 100 w/m/K will be presented along with discussion about more challenges to be overcome.