Laser-induced conductive layer on singlecrystalline diamond

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Diamond represents a promising wide- bandgap semiconductor for high power electronic devices. However, devices have not been realized due to difficulties in the doping process physically and technically. Recently laser irradiation has been a prime candidate as a new doping technique. In this work, we applied the laser-induced doping to singlecrystalline diamond immersed in dopant acid.

An insulating HPHT singlecrystalline diamond (100) plate (Ib) was immersed in a boric acid H3BO3(2%), and ArF excimer laser (193 nm) beams were irradiated at multiple frequencies and different laser fluencies up to 5 J/cm^2.

Current-voltage measurements showed the formation of semiconducting layers with high conductivities on the diamond surface. Since Raman spectra exhibited only peaks due to diamond and no peaks due to amorphous carbon, the drastically enhanced conductivity is not attributed to amorphous carbon formation but probably due to the incorporation of boron atoms into the diamond subsurface from the boric acid. Secondary ion mass spectrometric measurements showed the incorporation of boron atoms up to 40 nm depths from the surface. From cathodoluminescence measurements at low temperatures, it was difficult to detect peaks due to the substitutional incorporation of boron atoms into diamond due to thin thickness of doped layer. Details will be reported at the conference.

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