Oral presentation | 8 Plasma Electronics | 8.7 Plasma Electronics Invited Talk

[18a-234A-6~7]8.7 Plasma Electronics Invited Talk

Yoshihito Yagyu(Natl. Inst. of Tech.,Sasebo Col.)

Tue. Sep 18, 2018 10:30 AM - 12:00 PM 234A (234-1)

△：Presentation by Applicant for JSAP Young Scientists Presentation Award

▲：English Presentation

▼：Both of Above

No Mark：None of Above

11:15 AM - 12:00 PM

▲[18a-234A-7][INVITED] Low temperature plasma synthesis of novel nanomaterials

〇Lorenzo Mangolini[1] (1.UC Riverside)

Keywords:alternative plasmonics; refractory materials; in-situ characterization

In this talk we will discuss our recent progress in monitoring plasma-nanoparticle interaction via in-situ Raman and FTIR. We have taken advantage of the high optical cross section of carbon nanoparticles to measure their temperature in an argon-acetylene plasma. Both techniques provide experimental confirmation that the nanoparticle temperature can exceed 1000K even at moderate input power levels. This intense heating can be leveraged to produce nanoparticles of materials that are difficult to process. Beta-silicon carbide nanoparticles can be easily produced by nucleating silicon particles in a first plasma and by exposing them to a methane plasma placed in series with the first discharge. Simple calculations based on the enthalpy of formation of silicon carbide suggest that the nanoparticles temperature can be as high as 2000K during in-flight carbonization, consistent with the observation of high-quality crystalline silicon carbide particles. The use of such particles as inclusion in bulk thermoelectric materials will be described. We will also discuss the synthesis and processing of titanium nitride nanoparticles using low-temperature plasmas. Titanium nitride is notoriously difficult to produce in nanoparticle form. We have demonstrated that <10 nm TiN particles with near perfect stoichiometry can be obtained starting using titanium tetrachloride and ammonia as precursor couple. These particles show plasmon resonance in the near infrared, and are of interest for a variety of applications including photocatalysis and photo-thermal conversion. We have found that the optical properties are highly sensitive to the degree of oxidation of the material. A two-steps plasma process will be described in which titanium nitride nanoparticles are coated in-flight with a silicon nitride shell. This approach effectively prevents oxidation of the TiN particles, leading to a large improvement in their plasmonic response in harsh environments.