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Vertical graphene network as platform for electrochemical and bio applications

Mineo Hiramatsu[1], Keigo Takeda[1], Hiroki Kondo[1] and **Masaru Hori[2]**
[1]Meijo University, Japan
[2]Nagoya University, Japan

Graphene (monolayer and few layers) is a two-dimensional material with the large anisotropy between in-plane and out-of-plane directions. Carbon nanowalls (CNWs) are few-layer graphenes standing vertically on a substrate forming a self-supported network of 3-dimensional wall structures. This kind of carbon nanostructure is also called as carbon nanoflakes, carbon nanosheets, graphene nanosheets, and graphene nanowalls. CNWs are modified with several types of surface termination and decoration with metal nanoparticles and biomolecules. In addition, the potential window of CNW film is as wide as that of boron-doped diamond electrode. The maze-like architecture of CNWs with large-surface-area graphene planes can be suitable for the platform in electrochemical and biosensing applications. For the energy storage and power generation applications, CNW films can be potentially used as electrodes of capacitor, secondary battery, dye-sensitized solar cell, polymer electrolyte fuel cell, and implantable glucose fuel cell.

CNWs and similar vertical graphene materials can be synthesized by plasma enhanced chemical vapor deposition techniques on heated substrates (600-800˚C) employing methane and hydrogen mixtures. After synthesizing CNWs, the surface of CNWs was decorated with Pt nanoparticles by the reduction of chloroplatinic acid. It was confirmed that Pt-supported CNWs as electrodes of fuel cell had excellent durability comapred with the conventional carbon black. We report the current status of fabrication and structure control of CNWs, together with the performances of possible applications (fuel cells, hydrogen peroxide sensor, and scaffold for cell culturing), where CNW electrode was used.

Speaker Biography

Mineo Hiramatsu is a full Professor of department of Electrical and Electronic Engineering and the Director of Research Institute, Meijo University, Japan. His main fields of research are plasma diagnostics and plasma processing for the synthesis of thin films and nanostructured materials. He served as chairman and member of organizing and scientific committees of international conferences on plasma chemistry and plasma processing. He was awarded the Japan Society of Applied Physics Fellow in 2017.

e: mnhrmt@meijo-u.ac.jp

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