Sensing Molecules and Electrons Using Nanostructured Materials and Devices

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The sensitivities to detect molecules and electrons are enhanced by introductions of nanostructured materials. The three feature articles of this issue present and review research regarding this enhancement through multimolecular gas sensors, cell imaging, and single-electron motion sensors based on functionalized graphene, a periodic structure, and an ultra-narrow channel, respectively.

Prof. Uchida describes two types of molecular sensors based on Pd-functionalized suspended graphene and Pt nanosheets, respectively. Owing to its suspended structure, the temperature of graphene can change and be controlled very quickly, simply by changing the bias voltage, which results in the detection of H_2O and H_2 in the air. Prof. Tawa shows clear fluorescence images of neuronal cells enhanced by surface plasmon resonance. Various plasmon chips based on periodic metallic patterns with a wavelength-scale have been prepared and improved. The mechanism of the enhanced fluorescence by surface plasmons on plasmon chips is discussed. Dr. Nishiguchi demonstrates single-electron-resolution noise analysis by using a 10 nm-sized Si wire field-effect transistor at room temperature. They report a suppression of shot noise in a small capacitor under non-equilibrium conditions. The paradox of Maxwell's demon, which is an imaginary entity reducing the entropy of a system and generating free energy in the system, is also demonstrated by real-time monitoring of single-electron motion.

The following three feature articles focus on research that has contributed to the enhancement of the sensitivity of sensors by the introduction of nanostructures. We are pleased to introduce to the readers of the *AAPPS Bulletin* these interdisciplinary areas of research.

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