Hydrogel-Based Surface Enhanced Raman Scattering Sensor

Samir Kumar, Kyoko Namura, and Motofumi Suzuki
Department of Micro Engineering, Kyoto University, Nishikyo-ku, Kyoto, 615-8540, Japan
E-mail: Samir.kumar.2r@kyoto-u.ac.jp

Surface-enhanced Raman scattering (SERS) has emerged as a powerful analytical tool for the medical diagnostics and on-site sensing for disease markers. For such applications, it is imperative to detect the biomarkers directly from human skin. The plasmonic nanostructures used for the SERS are commonly in the form of solid substrates or as colloidal solutions, both of them are not very useful for such purposes. Gel-based SERS substrates, into which the plasmonic nanostructures are incorporated, may be useful for the direct collection of the biomarkers from secretions such as sweat. However, there are very few reports about the diffusion of molecules through the gel and on the study of an appropriate gel for the SERS applications.

To elucidate these points, we coated Au nano-island SERS chip with Hydroxyethylcelullose gel. Then, we deposited 20 µL droplets of 1 mM aqueous 4 4'-bipyridyl (BPY) solution onto the gel and recorded its SERS spectra as a function of time. The SERS signal intensity increases gradually with increasing time. Highly porous gel rapidly absorbed aqueous analyte solutions generating large SERS signals. The subsequent increase in signal could arise from the diffusion of the analyte molecule into the gel and onto the Au aggregates. Importantly, this gel-based SERS sensor did not significantly compromise the SERS performance of the analyte. We were able to detect Cortisol as low as 100 nm using this sensor. The proposed gel-based SERS sensor can be smeared directly onto the skin surface to absorb the body fluids from sweat, enabling the detection of biomarkers.

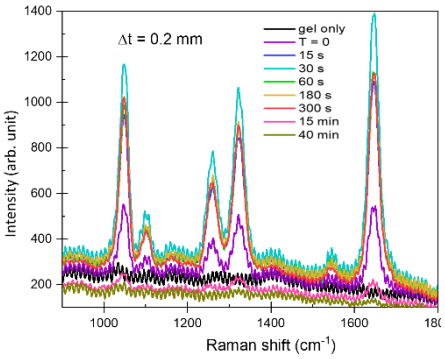

Figure 1. Time evolution of Raman spectra of 20 µL BPY with 0.2 mm gel thickness. T = 0 corresponds to time when the BPY was dropped onto the gel sample.