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プラズマ・液体界面反応を用いたナノ粒子含有薄膜のワンポット合成
One-pot Synthesis of Au-nanoparticle-embedded Thin Film Using Plasma-liquid Interfacial Reaction

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1. Introduction

Solution plasma can be used for various applications including nanoparticle synthesis and liquid treatment [1]. However, there are few reports on thin film formation using solution plasma [2]. In this work, we report that we can synthesize a free-standing film, which is cross-linked polymer with embedded gold nano particles (GNPs), on an aqueous solution irradiated with dielectric barrier discharge (DBD).

2. Experimental procedure

The aqueous solution was HAuCl4 (0.15, 0.30, and 0.60 mM) aqueous solution with gelatin (5, 10, and 20 wt%). The DBD system used in this study is shown in Fig. 1. Applied voltage was bipolar pulse voltage (amplitude 4 kV, frequency 40 kHz, pulse width 4 μs). Typical discharge time was 10 min. Discharge gas was argon.

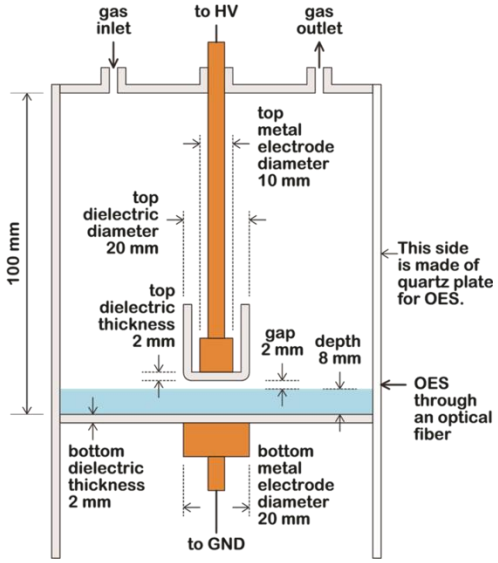

Fig. 1. A schematic diagram of the experimental setup.

3. Results and discussion

A film is formed on the aqueous solution by irradiating DBD plasma on the aqueous solution. Infrared absorption spectra of the film and energy dispersive X-ray spectra have indicated that the film is made of cross-linked gelatin and gold. Fig. 2. shows a transmission electron microscope (TEM) image of the sample taken from the outer edge of the film, which indicates that the synthesized GNPs are densely incorporated in the film. The size of GNPs seems to be regulated. Such size regulation may be explained in terms of immediate capture of reduced gold by growing film. The film formation process can be controlled by means of the concentration of HAuCl4 and gelatin and discharge duration, which affects the size and concentration of GNPs in the film.

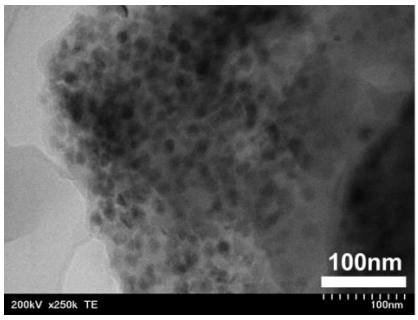

Fig. 2. TEM image of the film

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References

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