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Technology transfer of supercritical fluid deposition technology from research group to use in open nanotechnology facilities

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Type of Contribution: no preference

Abstract:

[Summary]

Due to the high integration, the plating of thin films on microstructures is becoming more important. However, deposition in microstructured trenches is difficult using conventional methods such as CVD and PVD. ALD has become popular but its drawback is slow deposition rate. To fulfil both coverage and speed, we focused on a supercritical deposition (SCFD) technique. In UTokyo, the technology was first investigated in a research laboratory (Shimogaki -Momose lab.) [1], and transferred to our nanotechnology facility. During the technology transfer, deposition conditions and cleaning procedure was developed [2] [3].

[Experiment]

Our initial failure experiments suggested adhesion of supercritical fluid deposition is greatly affected by the cleanliness at the interface of substrate. The following cleaning methods were found to be effective: APM (Ammonium hydrogen peroxide mixture) cleaning and BHF (buffered hydrofluoric acid) cleaning for Si substrates and acetone and IPA cleaning for metal films on Si substrates [4]. The deposition was carried out in a budge reactor (Fig. 1). Figures 2 and 3 show SEM images and EDS analysis of the deposition of a sample with a Ru seed layer deposited by ALD on a Si substrate in an environment of CO₂ 1.0 MPa, H₂ 10.1 MPa, 13 mg Cu precursor and a substrate temperature of 200°C at about 17 MPa. The SCFD Cu uniformly covered the 1.5µm-wide, 30µm-deep trench. Subsequently, Electrical Cu plating on this sample was performed and resulted good adhesion on the entire surface of the sample.

Fig. 1 Piping Diagram

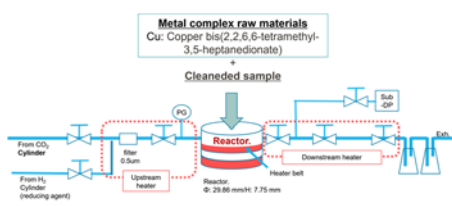


Fig. 2. Cross-sectional SEM view of SCFD Cu on narrow trenches

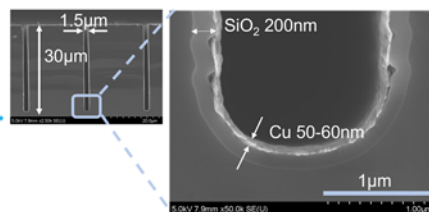
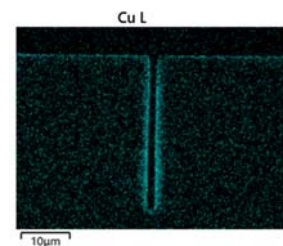


Fig. 3. EDS analysis



References:

- [1] T. Momose, *et al.*, *Appl. Phys. Express*, 1 097002 (2008)
- [2] N.Usami, E.Ota, *et al.*, *IEEJ Trans.on Sensors and Micromachines*, **140(1)**, pp. 31-36 (2020)
- [3] E. Ota, *et al.*, *Proc. 34th Sensor Symposium*, 01pm4-PS130 (in Japanese) (2017)
- [4] N.Usami, *et al.*, *Sensors and Materials*, **31(8)**, pp.2481-2496 (2019)

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