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Penetration of Ni-P Metal into polymer by Electroless deposition utilizing supercritical carbon dioxide

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Abstract

The flexible and biocompatible properties of polymer make flexible polymer MEMS promising candidates for the next generation of micro devices. Polyimide has both wide service temperature range and strong resistance to organic solvents, and thus is suitable for applications in hostile environments and could be easily cleaned and sterilized by conventional methods. In neurodevices, the flexibility of polyimide can provide strain relief against forces of “micromotion” between tissues and implanted devices. However, controlling the metallization on polymer in nano-scale level is necessary for manufacture of flexible bio-medical micro devices. Therefore, a novel jointing method between polymer and metal has been desired to provide the strain relief and the ability to control nano-scaled metallization on polymer.

The most advantageous point of the electroless deposition method is the ability to form metal films on non-conductive substrate in ambient temperature. Also, the capability of metal to penetrate into polymer can affect the adhesion between the metal layer and polymeric substrate. For the reasons, the penetration of Ni-P metal into polymeric substrate via catalyzation in supercritical carbon dioxide (Sc-CO_2) and electroless plating in sc-CO_2 emulsion, and diffusion of sc-CO_2 into the polymer are studied. There are two major merits for applying sc-CO_2 in the process of metallization on polymeric substrates, which are high self-diffusivity and good chemical affinity with polymer.

Ni-P thin films were fabricated utilizing sc-CO_2 emulsion with electroless plating following catalyzing in the sc-CO_2 with Pd complex. According to the EDX analysis, an increase in the sc-CO_2 catalyzation time led to increases in both the intensity and depth of the Ni-ion penetration depth into the polyimide substrate. We found that the impregnation reaction of Ni by our novel method is a sc-CO_2-diffusion-controlling reaction. The high diffusivity of the sc-CO_2 promoted the penetration of the Pd catalyst and Ni-P electroless plating solution into the polyimide substrate.

Biography

Masato Sone completed his doctor degree of engineering at the age of 28 years old at Tokyo Institute of Technology. He worked as a researcher in Nippon Oil Company from 1996-2000. He was an assistant professor and then a research associate professor at Tokyo University of Agriculture & Technology from 2000 to 2005, and he got the position of associate professor at Tokyo Institute of Technology from 2005 until present time. He has published more than 90 papers in scientific journals. His majorities are microelectronics, surface finishing, chemical engineering, liquid crystal and polymer science. His recent topic has been novel nano wiring process using supercritical carbon dioxide for integrated circuit technology.