CHARACTERIZATION OF CU NANO-COLLOID PREPARED BY WIRE ELECTRIC EXPLOSION PROCESS IN LIQUID

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Wire electric explosion process has been found about two hundred years ago and developed for the synthesis of nanoparticles from several ten years ago. It can be seen that energy deposited in the wire in the ohmic heating stage is larger in a dense medium. When a wire is exploded in a condensed medium, the resistance of discharge gap is higher than in air. For example, ohmic heating stage in water is almost twice as large as that in air. Wire electric explosion in liquid (WEEL) is possible to control the energy deposition in wire by changing the electrical breakdown, atomization enthalpy and expanding plasma, etc. Various kinds of liquids with different density are possible to use for medium in WEEL. Therefore, the properties of nanoparticles can be controlled by WEEL.

Ink-jet printing is a kind of noncontact and direct process as a pattern on demand type. It is also possible to make a conductive metal nanoparticles pattern simply, continuously and economically. Therefore, there are many kinds of merits on ink-jet printing process considering the application field like TFT, PCB, FPD, RFID, Solar cell, etc. To apply nanoparticles to electrical printing technology, long time stability of nanoparticles without contamination in liquid is indispensable. Wire explosion process in liquid is a kind of new process to prepare stable nanoparticle colloids with high purity.

Cu nano-colloid was prepared by wire electric explosion in de-mineralized water and anhydrous ethanol. Experimental instrument is composed of a high voltage power supply, a capacitor, continuous wire feeding system and an explosion chamber which is possible to contain various kinds of liquids. To control the properties of Cu nano-colloid, experimental conditions such as thickness of Cu wire and applied voltage are changed.

As shown in figure 1, Cu nano-colloids were successfully prepared by wire electric explosion in anhydrous ethanol with different concentration. The size of Cu nanoparticles in colloid is about 20 nm(figure 2). Dispersion stability of Cu nano-colloid was measured by transmittance of laser light. Ink-jetting property of Cu nano-colloid will be presented.

References:

[1] J. R. Greer and R. A. Street, Acta Mat. **55** (2007) 6345.
[2] R. Sarathi, T.K. Sindhu and S.R. Chakravarthy, Mater. Lettt. **61** (2007) 1823.
[3] A.E. Ter-Oganesyan, S.I. Tkachenko, V.M. Romanova, A.R. Mingaleev, T.A. Shelkovenko and S.A. Pikuz, Plasma Phys. Rep., **31** (2005) 919.
[4] A. Grinenko, Y.E. Krasik, S. Efimov, V.T. Gurovich and V.I. Oreshkin, Physics of Plasma **13** (2006) 042701.

Figures:

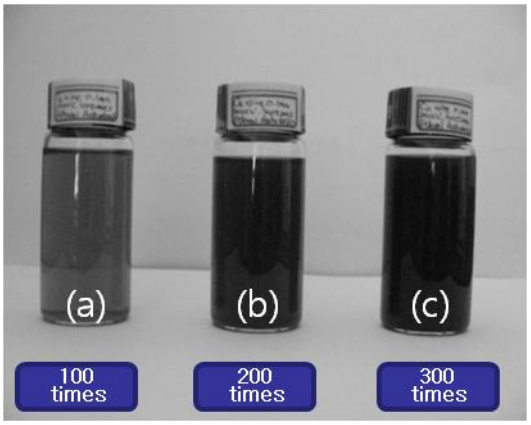

FIG. 1. Picture of Cu nano-colloids prepared by wire electric explosion process in anhydrous ethanol. (a) 100 times explosion, (b) 200 times explosion and (c) 300 times explosion.

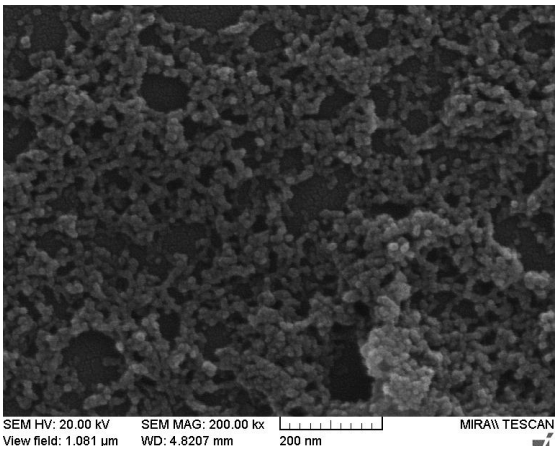

FIG. 2. SEM image of Cu nanoparticles. 2,500 V applied on 0.1 mm Cu wire.