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Preparation of Water-based Magnetic Fluid for Biomedical Applications

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The magnetic fluids hyperthermia(MFH) using the magnetic particles is to generate and control the heat in a body during the exposed state with external AC magnetic field. The cancer-diagnosis and medical treatment using magnetic fluids has no problem in transporting to the cancer tissue because of the use of magnetic nanoparticles, and the very effective treatment is expected due to the discharge of them after treatment. Also, the photodynamic therapy(PDT), which is activated with photosensitizer and light source, is a vital treatment method in recent cancer treatments[1]. Therefore, magnetic nanoparticles were prepared by chemical co-precipitation for hyperthermia and photodynamic therapy using water-based magnetic fluids with the improvement of efficiency of cancer treatment in this study.

The effects of precipitator, photosensitizer and surfactant for the magnetic particles were investigated for the proper control of particle size to enhance the treatment effect and the improvement of coating efficiency, and the increase of dispersibility to inhibit the agglomeration of nanoparticles in a body. These experiments were performed in vitro and in vivo test.

The solution of $FeCl_3 \cdot 6H_2O$, $FeCl_2 \cdot 4H_2O$ was prepared as a source of iron by dissolving the respective chemicals in pure water under intensive stirring with 450rpm. In the same way, NH_4OH and HCl were prepared as a alkali source and a solution for surface neutralization, respectively. Magnetic nanoparticles were coprecipitated by alkalinizing an

aqueous mixture of ferric and ferrous salts with ammonia water at room temperature [2].

From the results, when the reaction temperature and time were 80°C and 5min respectively, the case of NH_4OH as a precipitator had the higher saturation magnetization value than that of NaOH, in particular most superior in NH4OH 12ml. Also, when 5-aminolevulinic acid as a photosensitizer was applied to prepare the water-based magnetic fluid, which needed only the 1-step process relative to that hematoporphyrin required the 2-step, it improves the saturation magnetization value due to the decrease of the ratio of nonmagnetic materials per volume of sample compared with that for hematoporphyrin. And it appeared to be proper because it did not show the phase transformation at the temperature range of living body.

And, in vivo test, when starch and citric acid was used as a 1^{st} and 2^{nd} surfactants, the dosage was permitted up to 8% of total blood volume and groups with above 2% dosage in all samples appeared the dead animals. Also it appeared the clinical symptoms of uneasiness, impatience, stomachache, paroxysm, difficulty in breathing and thready pulse and the phenomena of embolism that the color of lung is changed into reddish brown.

References

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[2] Y. S. Kang, S. Risbud, J. F. Rabolt, P. Stroeve, Chem. Mater. **8**, 2209 (1996).