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蒸馏水中采用脉冲激光烧蚀制备Ag纳米粒子胶体

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摘 要：采用脉冲激光(重复率为10 Hz，能量密度为4.2 J/cm2)对蒸馏水中的Ag靶烧蚀不同时间后，制备得到Ag纳米粒子胶体，并对其进行紫外−可见分光光度计分析和透射电镜观察。结果表明：烧蚀时间为5~7.5 min时，Ag纳米粒子粒径及分布随烧蚀时间呈减少趋势，烧蚀时间从7.5变化至15 min时又随之增加，而烧蚀时间从15变化至25 min时又随之减少；获得的纳米粒子浓度增高，且溶液中粒子的团聚率也增大；烧蚀时间为7.5 min时，粒子粒径达到最小(D=14.48 nm)，粒径分布最小(d=25.8 nm)。在实验基础上，应用纳米粒子对脉冲激光自吸收产生的“爆炸”与“熔化生长”模型解释了烧蚀时间对纳米粒子胶体的影响规律，证实通过改变烧蚀时间来控制纳米粒子尺寸和形貌、以及防止纳米粒子发生团聚的可行性。

关键字： Ag；纳米粒子胶体；激光烧蚀；爆炸；熔化生长

Ag nanoparticles colloids produced by pulsed laser ablation in distilled water

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Abstract: Silver nanoparticles colloids were prepared by pulsed laser ablation for different time in distilled water with repetition rate of 10 Hz and laser fluence of 4.2 J/cm2. The nanoparticles colloids were characterized by UV-visible transmission spectrometry and transmission electron microscopy. The results show that the average diameter and its distribution of silver colloidal nanoparticles are decreased with prolongation of ablation time from 5 to 7.5 min, while then increased from 7.5 to 15 min, then decreased from 15 to 25 min. When the concentration of Ag nanoparticles becomes higher, the degree of aggregation in the solution also becomes higher. Furthermore, after ablating for 7.5 min, the average

diameter is the smallest (D=14.48 nm), and the diameter distribution is the narrowest (d=25.8 nm). Based on the experimental results, the effects mentioned above in terms of “fragmentation” and “melting induced growth” of nanoparticles is explained by self-absorption of laser pulses. Furthermore, it is also confirmed that both the control of nanoparticles size and shape and the prevention of nanoparticles colloid agglomeration are possible by condition of ablation time.

Key words: Ag; nanoparticle colloids; laser ablation; fragmentation; melting induced growth