Study on the energy relaxation dynamics of Ag, Cu nanoparticles embedded in soda-lime silicate glass fabricated by ion exchange

H. Zhou, Y. C. Wang, J. L. Ding , Q. Chen, and S. X. Qian
Department of Physics, Fudan University, Shanghai 200433, China

Motivation

- Dielectric with embedded metal nanoparticles have attracted a great deal of attention due to their potential application in the field of all optical switching devices.
- The decay processes of the nanocomposites are still controversial mainly due to the influence of the environment and the interface layer quality.
- Ion exchange has a number of advantages, including simplicity, low cost and optical fiber compatibility.

Experimental

- These samples were prepared by ion exchange followed by thermal annealing in hydrogen.
- The linear absorption spectra of the samples were measured by a Shimadzu UV-1601 spectrophotometer.
- In our investigation we utilize a standard femtosecond pump-probe configuration to perform time-resolved measurements of transient differential transmission (△T/T).

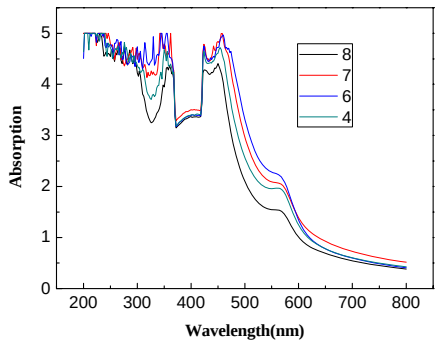

Figure 1 Linear absorption spectra of sample #4, #6, #7and #8

Table 1 List of #4, #6, #7and #8 samples

#4	0.05Ag-350℃-7d-H_2-350℃-30min-CuCl-500℃-3h- H_2-400℃-30min
#6	0.1Ag-350℃-7d- H_2-250℃-30min-CuCl-500℃-3h- H_2-400℃-30min
#7	0.1Ag-350℃-7d- H_2-350℃-30min-CuCl-500℃-3h- H_2-400℃-30min
#8	0.05Ag-350℃-7d- H_2-350℃-30min-CuCl-500℃-3h- H_2-400℃-15min

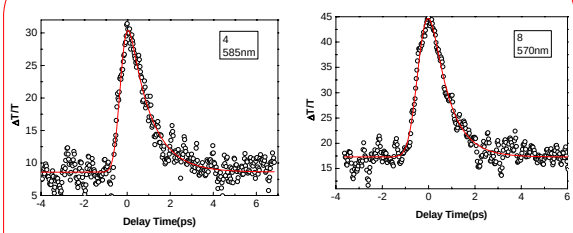

Figure 2 The experimental curves (dots) and the fitting results (solid line) of 800nm-585nm/570nm fs pump-probe measurement of samples #4 and #8, respectively

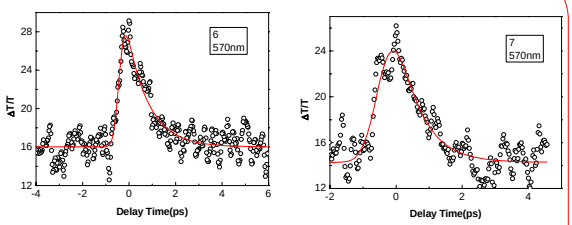

Figure 3 The experimental curves (dots) and the fitting results (solid line) of 800nm-570nm fs pump-probe measurement of samples #6and #7, respectively

Conclusions

- The linear absorption spectra indicated that Ag, Cu nanoparticles were formed individually.
- The dynamic process includes only one fast decay component. The fast decay process about several hundred femtoseconds is regarded as hot electrons thermal equilibrium and transferring energy to lattices by interaction with phonons.