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Ultrafast carrier dynamics and carrier localization in thermally annealed Si nanoclusters D.G. COOKE, A. HRYCIW, A.N. MACDONALD, A. MELDRUM, F.A. HEGMANN, Department of Physics, University of Alberta, Canada T6G 2J1 — We present results of time-resolved terahertz pulse spectroscopy experiments on thermally deposited and annealed Si nanoclusters embedded in a SiO_2 matrix. These clusters range in size but are on the order of 5 nm in diameter, which is comparable to the Bohr radius in Si where carriers are expected to be strongly localized. The frequency-resolved conductivity of these samples after excitation by a 400 nm, 100 fs pump pulse is non-Drude like with a real component that increases with frequency and a negative imaginary component indicative of carrier localization. A series of samples is investigated as a function of anneal temperature, showing transient absorption decays ranging from a few picoseconds to several hundred picoseconds as the anneal temperature increases. Several models to explain the observed response are discussed. The authors acknowledge financial support from NSERC, CIPI and iCORE.

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