

A Critique of the Existing Models for Excitation
Exchange Between Silicon Nanoclusters and Erbium Ions
in Silica

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The existing model for the well-established excitation exchange mechanism that exists between silicon nanoclusters and erbium ions assumes a Förster interaction between a dipole and an induced dipole. This study analyses the implications of assuming a Coulombic interaction and, using the interacting dipole model, values for the critical Förster radius, r_0 , are determined for a number of samples. The results suggest that the interaction range is of the same order as the nanocluster radius – a conclusion that suggests that the accepted exchange model is not correct. Other models, including exchange interactions have been proposed in the literature, but it is shown that it is not possible to distinguish between the predictions of these and Förster theory on the basis of available data. Instead, it is likely that the high degree of disorder in the Si:Er:SiO₂ system produced by broad size distributions of silicon nanoclusters necessitates revision of the simple dipole-induced dipole model.