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ENERGY LOSS AND INELASTIC SCATTERING OF PHOTOELECTRONS IN N_2 DOPED SOLID Kr

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The method of matrix isolation of reagents in inert matrix is usually used to study of chemical reaction molecular dynamics along with methods of molecular beams and femtosecond probing spectroscopy [1]. Matrix-assisted energy transfer to matrix-isolated species is one of the most powerful tools for photostimulated chemical reaction control, and rare-gas solids are the most popular media for such investigations [2]. In Rare Gas Solids the energy loss rate of photoelectrons with energies above the band gap energy is mainly determined by electron-electron scattering [3]. The scattering of a hot photoelectron by a valence electron results in the formation of an additional electron-hole pair which can be bound or free. Such processes of multiplication of excitations with well-defined thresholds lead to prominent structures in the photoluminescence excitation spectra [2]. The influence of inelastic electron-electron scattering processes on quantum efficiency of intrinsic photoluminescence have been the subject of continuous interest as a powerful tool to investigate the relaxation mechanisms in Rare Gas Solids [4]. Solid krypton doped with N_2 was extensively used to investigate intra- and intermolecular energy relaxation into the impurity subsystem [5]. Because of the fast electronic relaxation by the intersystem crossing to the lowest excited $A^3\Sigma_u^+$ state and the pronounced Vegard-Kaplan bands emission, N_2 can be used as a sensitive luminescent probe to detect electronic relaxation at an impurity. This paper reports the observation of the influence of inelastic photoelectron scattering on luminescence of N_2 doped solid Kr.

The photoluminescence experiments were carried out at the SUPERLUMI experimental station at HASYLAB, DESY, Hamburg [6]. Solid krypton exhibit strong effects of neutral and charged defect formation induced by electronic transitions [2]. Therefore all measurements were carried out after saturation of dose effects at steady concentration of point defects and ionic centers. Under selective excitation by synchrotron radiation the threshold energies for multiplication of electronic excitations were measured. The data obtained suggest that in N_2 doped solid Kr three types of photoelectron scattering exist: (i) long-range photoelectrons are scattered inelastically by the impurity molecules, (ii) short-range photoelectrons with energies about $E_g + E_{exciton}$ form electronic polaron complexes, (iii) photoelectrons with energies above $2E_g$ can create intrinsic ionic centers as a result of formation of secondary electron-hole pairs during scattering. The influence of mean free path of photoelectrons on scattering process is discussed.

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