# Non-radiatve energy transfer process in Nd-doped laser glasses

*Gan Fuxi*    *Chen Shuchun*    *Hu Hefang*

(Shanghai Institute of Optics and Fine Mechanics,
Academia Sinica)

The study on the non-radiative transition process of active ions in laser materials is undoubtedly important. Up to date, the non-radiative transition in laser crystals which results from the interaction between active ions and matrix, is described by the multiphonon relaxation of the crystal lattice vibration. The same mechanism is also applied to Nd-doped inorganic glasses. Several kinds of Nd-doped glasses, including oxide glasses, fluoride glasses as well as oxide-fluoride mixed glasses were prepared. Their absorption spectra, fluorescence spectra, relaxation spectra and infrared vibration spectra were measured. The non-radiative transition probability and multiphonon transition probability of various Nd-doped glasses were calculated. It is shown that the non-radiative transition process, caused by the interaction between $Nd^{3+}$ ions and base glass, can not be explained perfectly by the multiphonon relaxation. It is pointed out that a short-distance interaction, i. e. partial overlap of orbital wave function between 4 f-electrons of neodymium ions and ligand, also exists in Nd-doped glasses because of covalent bond contribution between active ions and ligand. The influence of the short-distance interaction on the non-radiative transition process is stronger than that of the multiphonon relaxation in glasses. Consequently, it is considered that the non-radiative transition in glasses is like to an inter-molecular energy transfer process.

# 掺钕激光玻璃的无辐射能量转移过程

干福熹    陈述春    胡和方

(中国科学院上海光学精密机械研究所)

激活离子无辐射跃迁过程的研究对于激光材料无疑是非常重要的。目前激光晶体中由激活离子与基质相互作用而引起的无辐射跃迁都用晶格振动的多声子弛豫过程来描述。相同的机理也应用到无机掺钕玻璃。我们研究了一系列不同类型的掺钕玻璃(包括各种氧化物玻璃,氟化物玻璃以及氧化物-氟化物玻璃)的吸收光谱,荧光光谱,弛豫光谱以及红外振动光谱。测定了各种类型掺钕玻璃的无辐射跃迁几率,计算了多声子跃迁几率。实验表明,由钕离子与基质玻璃的相互作用而引起的无辐射跃迁过程,不能完全用多声子跃迁来解释。由于无机玻璃中激活离子与最邻近配位体之间的共价键因素,即钕离子的 4f 轨道与配位离子的电子轨道的波函数有一定程度的混杂,所以在玻璃中还存在一种近距离的相互作用。它们对无辐射跃迁过程的影响比声子弛豫过程更强烈。因此,可以认为玻璃中的无辐射跃迁是属于类似内分子的能量转移过程。