# Investigation of the optical properties of single-walled carbon nanotubes doped in acid medium

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Single-walled carbon nanotubes have unique optical and electronic properties [1]. One of the most prominent features of carbon nanotubes is the strong correlation between carriers due to the quantum limitation that occurs in one-dimensional (1D) structures. The repulsive electron-electron and attractive electron-hole interactions play an important role in the electronic and optical properties and lead to the appearance of excitons with a significant binding energy [2]. The exciton is a quasiparticle, which is a bound state of an electron and a hole.

When doping nanotubes, trions may arise [3]. Trion is a quasiparticle, which is a triplet of electrons and holes bound by Coulomb forces.

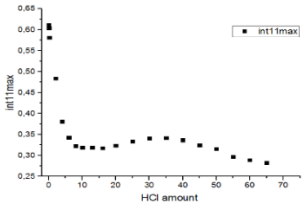


Fig. 1. Dependence of the maximum of the first exciton transition on the amount of added acid HCl (mkL).

In this paper, we study the change in the spectra of photoluminescence, Raman scattering and optical absorption when the nanotubes are doped with HCl acid. As a result, it is necessary to maintain a certain time interval between doping and measurement, and an increase in the trion peak with an increase in the doping level was observed. These results are shown in *Fig. 1*.

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[1]Saito, R.; Dresselhaus, G.; Dresselhaus, M. S. Physical Properties of Carbon Nanotubes; Imperial College Press: London, 1998.
[2]T. Ando, J. Phys. Excitons in carbon nanotubes Soc. Jpn. 66, 1066 (1997).
[3]Shinichiro Mouri, Yuhei Miyauchi, Munechiyo Iwamura and Kazunari Matsuda, Temperature dependence of photoluminescence spectra in hole-doped single-walled carbon nanotubes: Implications of trion localization, Japan, 2013.