Effect of Nitrogen doping on the Fluorescence property of Carbon dots synthesized through Solution Plasma

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Solution plasma (SP) leads to polymerization of organic monomer by electron exchange reaction at the interface between plasma and liquid. Using the SP method, many types of carbon nanomaterials are synthesized from organic solvents. Especially, the synthesis of the hetero-atom doped carbon nanomaterials at room temperature is one of the advantages of the SP method. Recently, Carbon dots (CDs) have received much attention due to their optical property by the photon transitions among the electronic bands. Moreover, the property of carbon dots can be controlled by hetero-atom doping. Therefore, the SP method can be one of the effective ways to synthesize nitrogen-doped CDs.

In our group, nitrogen-doped (N) CDs were successfully synthesized using pyridine and benzene through SP method. The nitrogen composition of NCDs was controlled from 5 to 12 at.% by different ratio of pyridine and benzene solution. The NCDs showed an absorption band located around 250 nm wavelength, which was assigned to π-π* transition. Moreover, an absorption band of n-π* transition located around a wavelength of 340 nm was detected, which became stronger with the increase of nitrogen concentration. The quantum yield of NCDs, which means the emission efficiency of the absorbed photon, shows the maximum value of 28% by increasing of N concentrations. The NCDs emitted a strong blue fluorescence light around 410 nm under the UV light excitation at 340 nm. In the results of fluorescence spectra, the emission range of NCDs is more narrower gradually by increasing of nitrogen concentration. Also, as a result of comparing PLE (photoluminescence excitation) spectra according to nitrogen concentration, it was confirmed that the excitation wavelength of 350 and 385 nm exists in the case of low nitrogen content, however, the excitation wavelength of 385 nm decrease by the increasing of nitrogen concentration. The new electronic bands(n) are generated between the π-π* electron bands by nitrogen and oxygen atom, however, the electronic band associated with nitrogen becomes dominant as the nitrogen concentration increases.