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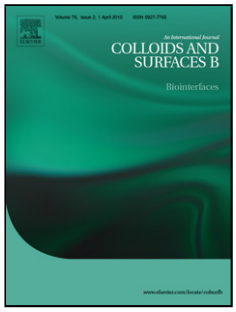

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Nontoxic fluorescent carbon nanodot serving as a light conversion material in plant for UV light utilization

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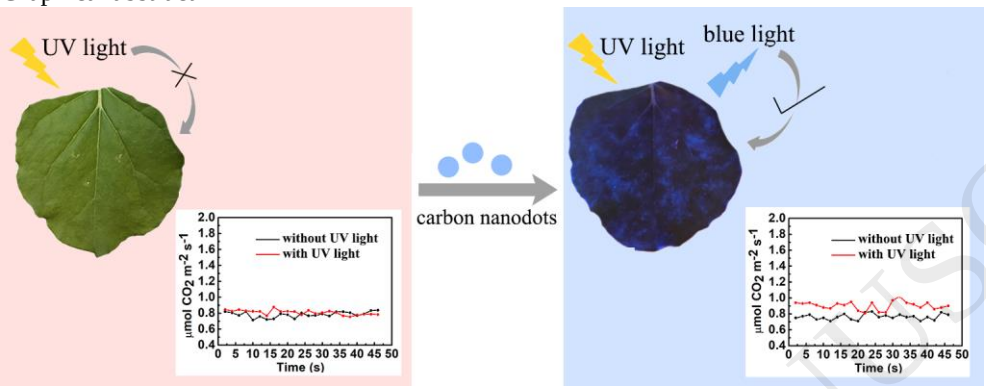
Graphical abstract



Highlights

- Fluorescent carbon nanodot serving as a UV-to-blue light conversion material for UV light utilization in solar energy.
- Comparation of the photostability and toxicity of carbon nanodots with different kinds of surface groups in live plant.
- Direct injection of the carbon nanodots to the plant leaf and *in vivo* light conversion effect.
- Improvement of photosynthesis of the plant leaf loaded with nontoxic carbon nanodots.

ABSTRACT

In this study, water-soluble fluorescent carbon nanodots (CNDs) were directly injected into the leaf of *nicotiana tabacum*. With the help of UV-to-blue light conversion nanomaterial, the photosynthetic rate of the leaf was improved 18% upon additional 6 W UV irradiation. The photostability and toxicity of different kinds of CNDs were discussed. The results showed that CNDs functionalized with NH_2-groups on their surfaces could maintain good fluorescence in plant leaf, and CNDs with complex surface groups tended to have high toxicity to the plant. The NH_2-functionalized CNDs with non-toxicity and good photostability were used as i*n vivo* light conversion material for direct utilization of UV light in the solar energy.

Keywords: fluorescent carbon nanodots; nanotoxicity; photosynthesis; light conversion

1. Introduction

The solar spectrum is extremely important for the growth of plants besides water and oxygen. In general, necessary irradiation light for plant exists in three regions from the solar spectrum: blue (400-500 nm), red (620-690 nm), and far red (739-735 nm), the ultraviolet (UV) and green components of the solar spectrum cannot be utilized by plants. Especially, UV radiation to the ground has increased because of the depletion of the ozone layer, which is caused by releasing of the chemical substances these years. Therefore, it will be useful to convert UV light into a band that can be absorbed by plant, which will not only reduce the damage of UV irradiation to the plant, but also promote plant growth.

Generally, the property of a light conversion material depends on its absorption (Abs) and photoluminescence (PL) bands. So far, various kinds of light conversion materials have been developed in recent years. They could successfully convert UV-