

ICNTCCONFERENCE

INTERNATIONAL CONFERENCE ON NEW TRENDS IN CHEMISTRY

**10TH INTERNATIONAL CONFERENCE ON
NEW TRENDS IN CHEMISTRY
APRIL 19-21, 2024**

10th ICNTC BOOK OF ABSTRACTS

<http://www.icntcconference.com/>

10th ICNTC Conference 2024

10th International Conference on New Trends in Chemistry

Published by the ICNTC Secretariat

Editor:

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ICNTC Secretariat

Büyükdere Cad. Ecza sok. Pol Center 4/1 Levent-İstanbul

E-mail: icntcconference@gmail.com

<http://www.icntcconference.com>

Conference organised in collaboration with Monre Academy

ISBN: 978-605-73406-3-4

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Composite Thin Films of Upconverting Nanoparticles: Characterization of Emission and Energy Transfer Properties

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Abstract

Upconverting nanoparticles (UCNPs) are able to emit photons of higher energy - i.e. shorter wavelength – when excited by photons of lower energy (anti-Stokes effect)[1].

The aim of our research was the development of UCNP-containing functional composite thin films using silica, titanium dioxide and chitosan biopolymer as matrix materials. The main objective was to maximise the intensity of anti-Stokes emissions of the upconverting nanoparticles in the thin film systems. We aimed to control the composition of the matrix material, and the parameters of the coating formation process to maximise the upconversion emission intensity. The highest emission intensities were achieved using chitosan biopolymer as matrix material. Moreover, in case of chitosan matrix material no heat treatment was necessary during the coating process.

The energy transfer interactions between UCNPs and Rhodamine 6G fluorescent model dye molecules were also investigated. Energy transfer was measured both in suspensions and chitosan matrix composite coatings. The results of the radiative interactions in the developed composite thin film systems can later be utilised, among others, in the field of photodynamic cancer therapy[2] or efficiency enhancement of photovoltaic devices[3].

Key Words: *upconversion, upconverting nanoparticles, composite coatings, chitosan, energy transfer*

Acknowledgement

Supported by the ÚNKP-23-2-II-BME-254 New National Excellence Program of the Ministry for Culture and Innovation from the source of the National Research, Development and Innovation Fund. This research is part of projects no. TKP2021-NVA-02 and TKP2021-EGA-02, which have been implemented with the support provided by the Ministry of Culture and Innovation of Hungary from the National Research, Development and Innovation Fund, financed under the TKP2021-NVA and TKP2021-EGA funding scheme. The publication of the work reported herein has been supported by ETDB at BME.

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