Light-emitting device based on Carbon Dots /Porous Silica nanocomposite

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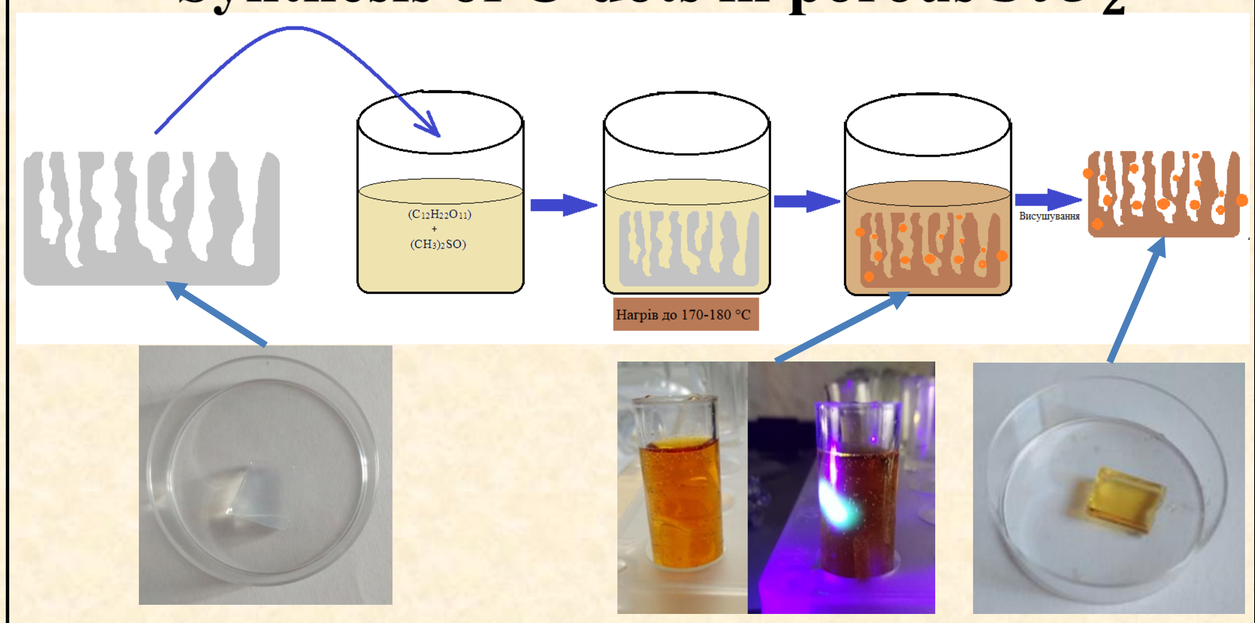
Motivation

- ✓ Organic-inorganic nanocomposites – new materials combining the advantages of matrix and nanoparticles;
- ✓ C-dots are very effective luminophore (broadband PL in the visible range; the efficiency is sufficiently high at T_{room});
- ✓ The controlled synthesis of C-dots in SiO_2 matrix.

Goal

To fabricate C-dots in porous SiO_2 matrix, with environmentally friendly reaction conditions, to study the applicability of the nano-composite as a luminescent material.

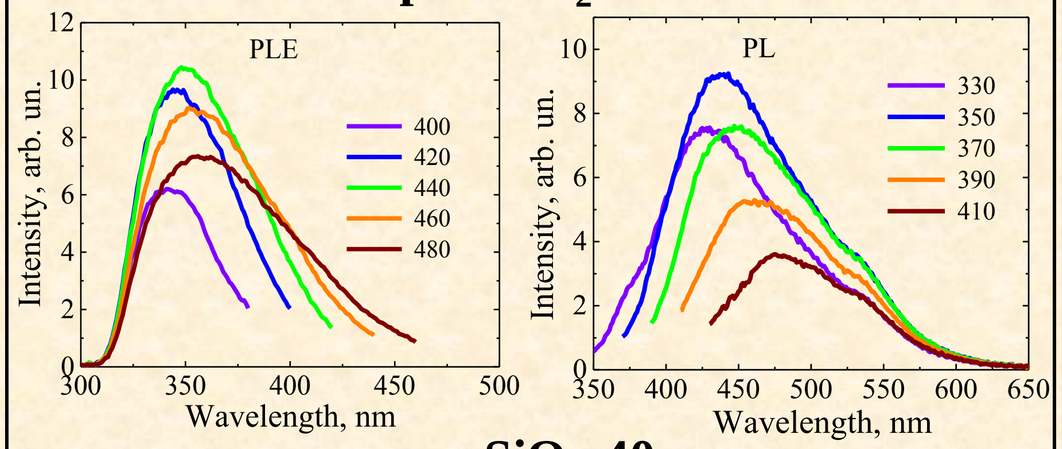
Synthesis of C-dots in porous SiO_2



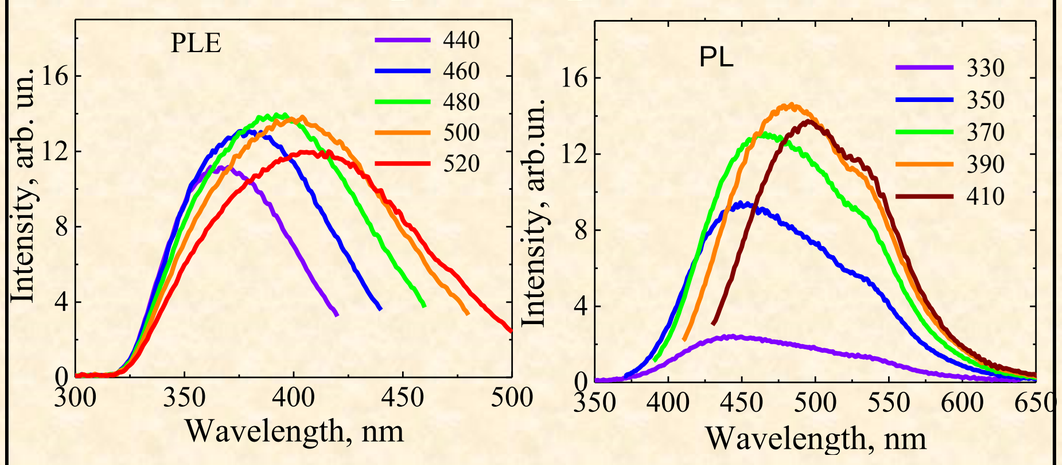
- ✓ Synthesis *in situ*;
- ✓ "Green" method;
- ✓ Precursors:
  - SiO2 samples with the average sizes of pores of 7 and 40 nm,
  - Solution of sucrose (C12H22O11) in DMSO (CH3)2SO).

PLE and PL spectra of impregnated SiO_2

por-SiO_2 7 nm

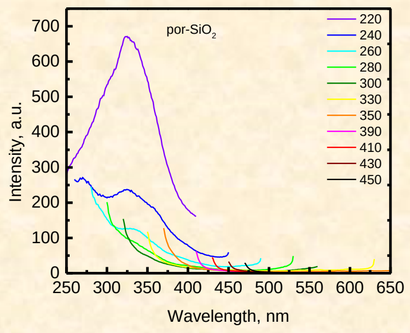


por-SiO_2 40 nm



- The asymmetric shape of PL spectra - overlap of the emission of the core of carbon nanoparticles and the functional groups on their surface;
- "Red" shift of the PL spectra (por-SiO_2(40) → por-SiO_2(7)) = change of C-dots average size;
- PL and PLE spectra are significantly broadened;

PL spectra of "empty" SiO2 matrix

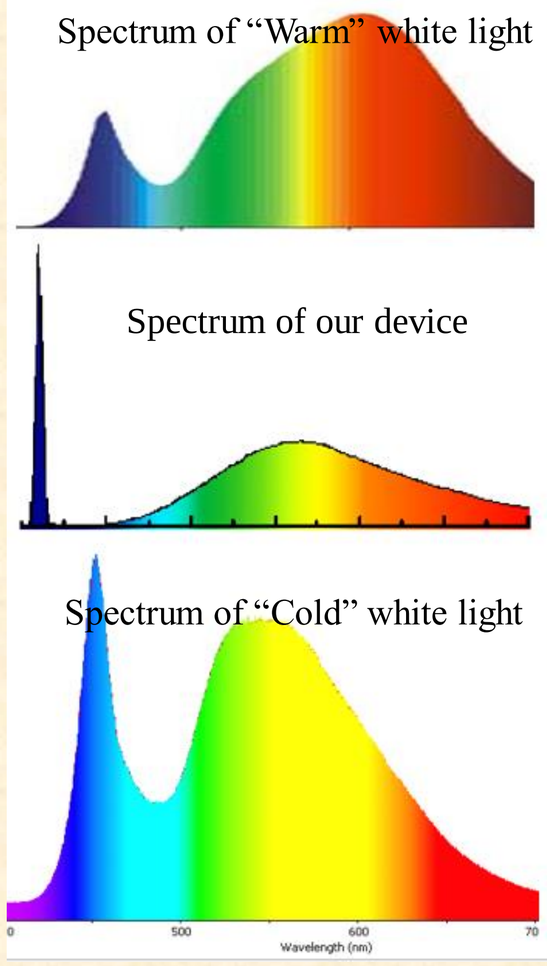


- Strong PL in UV-region;
- No PL of por-SiO_2 in the same region that in nanocomposite;

Matrix does not contribute to the resulting perception of color

Model of solid-state light-emotive device based on C-dots in porous SiO_2

Light is perceived by the eye as something in between "warm" and "cold" white light.



Conclusions

- ✓ We proposed model of light-emitting device based on C-dots;
- ✓ Device emits white light;
- ✓ Carbon precipitates were obtained as a result of sucrose decomposition;
- ✓ The shape of PL and PLE spectra are typical for the emission of carbon nanoparticles;
- ✓ C-dots with larger size are formed in por-SiO_2(40) templates as compared with por-SiO_2(7).