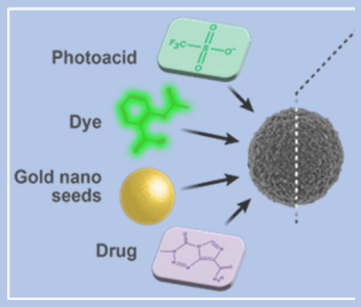
Department of Physical Electronics
School of Electrical Engineering
The Iby and Aladar fleischman Faculty of Engineering
Tel Aviv University

Department Student Seminar

Hani Barhum

Ph.D. student under the supervision of Prof. Pavel Ginzburg



Tuesday,
January 30, 2024

15:00-16:00
Room 011 Kitot Building

optically responsive theranostic vaterite

וטריט טרנוסתי עם היגב אופטי

Abstract

This research aims to harness the full potential of vaterite nanoparticles, a calcium carbonate polymorph, as a multifunctional theranostic platform for drug delivery, imaging, and sensing. A systematic approach was undertaken involving the controlled synthesis, characterization, and application of vaterite particles functionalized with new organic and inorganic materials in order to tailor their optical properties and its molecular loading-release dynamics. Extensive structural and optical characterizations were conducted, followed by in vitro assessments of biocompatibility and toxicity. Controlled parametric reactions enabled the synthesis of vaterite particles of varying sizes (200 nm to 7 microns), aspect ratios, and geometries, thereby influencing their molecular load-release capacity profiles, and also the cellular uptake. Dark field spectroscopy and modelling were utilized to assess the optical scattering intensity. Passive plasmonic gold nanoparticles were synthesized into vaterite pores and on its surfaces, enabling the formation of on demand resonant composites. These composites facilitated the localization of the electric field excitation, resulting in controlled heating and vapor bubble formation. Additionally, optically-tuned carbon dots (CDs) were developed and incorporated into vaterite, enabling colorful imaging, metal ion sensing in blood serum and the tracking of vaterite nanoparticles in mouse brain vessels using two-photon imaging. Finally, dissolution rates of vaterite particles were assessed after functionalization with polymeric entities, and photoacid-soaked vaterite particles were employed to control the release of the drug temozolomide on a glioblastoma cell line in vitro. This study highlights the versatility and potential of vaterite as a theranostic platform, contributing to advancements in drug delivery, imaging, and sensing applications.

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