

Seminar

Carbon Nano-Onions as Targeted Nanocarriers for Cancer Therapy

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Abstract:

Carbon nano-onions (CNOs) are multi-layered fullerenes composed of concentric sp^2 -hybridized carbon shells. Owing to their small size, high surface area, tunable surface chemistry, and excellent biocompatibility, they are emerging as versatile nanocarriers for targeted drug delivery.

We established a reliable synthetic strategy to produce pure, monodisperse CNOs and engineered their surfaces with targeting and imaging functionalities. These nanomaterials exhibit strong photostability in aqueous environments, selective uptake by cancer cells, and minimal cytotoxicity.

For tumor-specific targeting, supramolecular functionalization with a hyaluronic acid–phospholipid conjugate (HA-DMPE) enabled selective recognition of CD44-overexpressing cancer cells. HA-DMPE–CNOs demonstrated enhanced uptake in CD44⁺ breast cancer cells compared to CD44⁻ ovarian cells, while zebrafish studies confirmed *in vivo* biocompatibility.

Boron nitride–doped CNOs further enabled pH-responsive doxorubicin release, resulting in improved cellular uptake and anticancer activity in breast cancer cell lines (MDA-MB-231, MDA-MB-468, MCF-7) compared to free DOX and Caelyx[®], with reduced cardiotoxicity in AC16 cardiomyocytes. Additionally, gemcitabine-loaded HA-CNOs showed strong activity against pancreatic cancer cells, and folic acid–modified CNOs achieved receptor-mediated targeting with controlled drug release.

Overall, these findings establish CNOs as safe, adaptable, and highly effective platforms for precision cancer nanotherapy.

Thursday **17.04** 2026 **3:00 p.m.**

Room T.02b - Ca' Vignal 3
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