X-ray and Light-Responsive Azo-Micelles for Controlled Drug Release and MRI Monitoring

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The development of stimuli-responsive nanocarriers represents a promising strategy to enhance the spatiotemporal control of drug delivery in cancer therapy. Among the most promising candidates are azobenzene-based amphiphiles, whose reversible photoisomerization allows dynamic control over micellar assemblies. When combined with metal chelates such as gadolinium (Gd), these systems offer a unique opportunity to engineer multifunctional nanocarriers that respond not only to light but also to ionizing radiation (IR), enabling both imaging and stimulus-triggered therapy. In this context, we investigate a Gd-functionalized azobenzene amphiphile, known as Azo-DOTA, that self-assembles into micelles capable of undergoing structural disruption upon UV or X-ray exposure, resulting in controlled drug release [1,2].

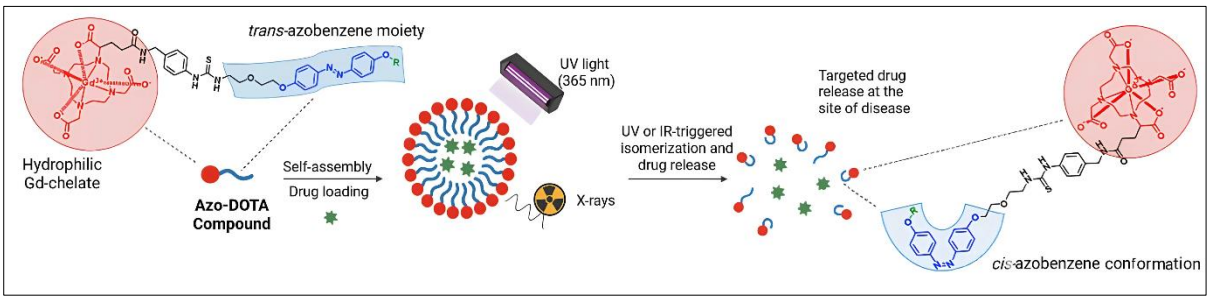

Figure 1. Schematic representation of an Azo-DOTA compound comprising (i) an ionizing radiation (IR)-responsive Gd chelate (red), (ii) a light-sensitive azobenzene photoswitch (blue), and (iii) variable hydrophobic chains (green, R). The diagram also illustrates micelle self-assembly and its disruption upon UV or X-ray exposure via azobenzene isomerization, triggering drug release.

We are currently synthesizing structural analogues with varying hydrophobic segments to fine-tune micelle stability, drug-loading efficiency, and sensitivity to external triggers. These systems are characterized using Dynamic Light Scattering (DLS), and their release behavior is evaluated under both UV and X-ray exposure. Preliminary *in vitro* experiments will assess cytotoxicity and therapeutic efficacy in cancer cell models.

This study contributes to the design of dual-stimuli-responsive micellar systems that integrate MRI-based diagnostics with externally triggered drug release, offering new possibilities for spatially and temporally controlled cancer therapy.

References

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