Gallium Mediated DNA Tensegrity Triangle Based Crystals: A Novel Prototype Facilitating Gallium Cancer Therapy

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Gallium Cancer Therapy (GCT) has emerged as a promising non-invasive treatment modality due to its ability to induce apoptosis and disrupt cellular iron metabolism, inhibiting rapid proliferation of cancer cells. Despite its therapeutic potential, clinical applications are limited by challenges in controlled release and targeted delivery of current gelatin based capsules, prematurely releasing gallium to non-cancerous cells, thereby inducing apoptosis. Thus, the DNA tensegrity triangle based crystal, with its precise structural design and programmability, may serve as an optimal motif for creating multifunctional nanostructures for targeted gallium ion delivery. I engineered a novel GCT crystal prototype that utilized gallium mediated B-DNA tensegrity triangles for targeted transport to cancerous cells by programming three specific binding sites for gallium ions within the motif. Using only High MOPS buffer as the crystal environment, I created 12 crystals with an average size of 45μm, smaller than previous studies containing metal mediated base pairs of 200μm. Due to its small crystal size, I was unable to use X-ray Diffraction for atomic level detection. Instead, I used Multiwavelength Anomalous Diffraction scan analysis to localize gallium ions by anomaly patterns. My greatest anomaly wave energy was 10378.1 eV, closely aligning with gallium's identification wave energy 10370.0 eV ($p<1*10-19$), which confirmed gallium's presence in the motif. Despite small crystal size, I created the first DNA tensegrity triangle with gallium ion mediation. Future applications may modify this novel prototype for Z-DNA to evade the immune system creating the first gallium DNA mediated cancer therapy.

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