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A Study of Polyhedral Boron Clusters in The Treatment of Cancer Using Boron Neutron Capture Therapy

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ABSTRACT

Polyhedral boron clusters play an important role in the advancement of cancer treatment through **Boron Neutron Capture Therapy (BNCT)**. BNCT is a targeted radiotherapy technique that utilizes the nuclear reaction between boron-10 isotopes and low-energy neutrons to destroy cancer cells selectively. In this therapy, boron-containing compounds are first introduced into the patient's body and accumulate preferentially in tumor cells. When the tumor area is exposed to a beam of thermal neutrons, the boron-10 atoms capture the neutrons and undergo a nuclear reaction that produces high-energy alpha particles and lithium nuclei. These particles have a very short path length and therefore destroy cancer cells while minimizing damage to surrounding healthy tissues. Polyhedral boron clusters, such as carboranes and closo-boranes, are particularly valuable in BNCT because they contain a high number of boron atoms in a stable molecular structure. Their unique chemical stability, three-dimensional geometry, and ability to be attached to biologically active molecules make them effective carriers for delivering boron to tumor tissues. Researchers have developed various boron cluster-based compounds that can selectively target cancer cells, improving the efficiency of BNCT. Additionally, these clusters can be modified chemically to enhance their solubility, biocompatibility, and tumor selectivity. As a result, polyhedral boron clusters have become a promising area of research in cancer therapy, offering the potential for more precise and effective treatment with reduced side effects compared to conventional radiation therapies.