Simulating Efficiency of Tokamak Fusion Reactor Wall Materials in Neutron Moderation for Lithium Breeding

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Currently, fusion reactors run on deuterium, which is very abundant, and tritium, which is almost nonexistent on earth. Tritium's scarcity poses one of the greatest barriers to efficient fusion energy production. Lithium-tritium breeding is one proposed solution. Tritium can be produced by exposing lithium to the high energy neutrons created by nuclear fusion. If reactors can produce their own fuel, it could finally make fusion energy viable, producing almost limitless amounts of energy for the world. Several lithium "blanket" designs are being tested now by ITER, the leading organization in fusion energy. The blankets, which line the walls of the fusion reactor, are composed of varying lithium compounds. Alongside being tritium producers, these materials must be efficient neutron moderators. The more energy that can be captured, the more tritium can be produced. This experiment attempts to select a prime candidate for this material, comparing the moderation efficiency of lithium compounds proposed for use in fusion reactors. Using Geant4, a nuclear physics simulation software developed by CERN, neutrons are collided with the samples and the energy deposits are calculated. It was found that lithium oxide performed as the best neutron moderator. Future studies should consider the geometry of the blanket, as some materials may work better in liquid form, pebbles, or small bricks.

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