PROGETTO BOLas

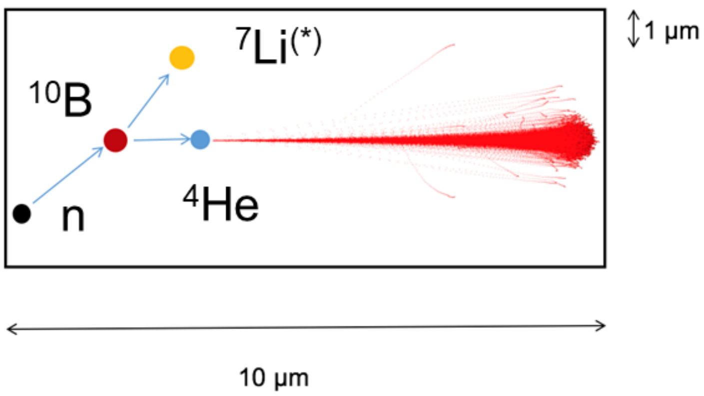
BoLas–Flexible ^{10}B-based converter deposited by the **laser ablation technique**

CEntro di Fisica Applicata, DAtazione e Diagnostica

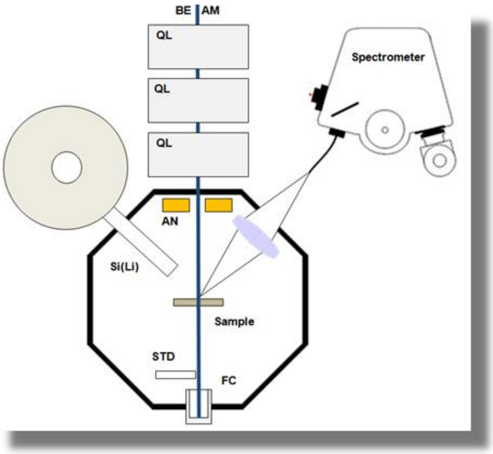
I n this project the pulsed laser ablation technique for the deposition of a ^{10}B enriched film in order to realize a flexible neutron converter was used. The meaning of flexible is twofold being related to i) the possibility to deposit on flexible substrate like kapton (polyimide), membranes and ii) the possibility to apply/deposit the ^{10}B on different existing (scintillation fiber, silicon detectors, CR39.) and new detectors (based on high T superconductors) to be used in many applications.

The PLD is a consolidated and interesting technique. The beam of a pulsed laser is focused on the surface of a material we want to produce in a thin-film configuration with enough power density to promote its ablation (10^6 - 10^9 W cm^{-2}). Above a threshold value of the laser fluence a prompt ejection of target material occurs. In fact, the photon energy absorbed by electrons is transferred to the lattice of the irradiated material leading to a drastic increase of the material surface temperature, which turns the lattice into an unstable phase that leads to congruent ablation of material.

Ultra-violet laser light was used, since it efficiently couples with most materials, at energy density of the order of 1 J/cm^2 , pulse duration of the order of 10 ns and pulse repetition rate of the order of 10 pulses/s. The ablated material deposits on a suitable substrate placed a few cm downstream. High deposition rate, of the order of 0.1 nm/s were obtained. PLD was successfully applied to a wide range of materials, like semiconductors, metals, alloys and compounds. The ability to deposit thin films with monolayer thickness with the ability to deposit thin films with monolayer thickness control, good film-to-substrate adhesion, minimum material consumption, complex compositional profiles on substrates at room or at low temperatures are the most significant advantage of this technique. The ablation can also be performed in low-pressure atmosphere (of the order of 1 Pa, or less) to promote a chemical reaction between the ablated material and the environment chemical species.



For what concern ^{10}B, very interesting is the possibility to deposit this material in thin film form at room temperature on flat or 3D thermolabile substrate with good adherence preserving the stoichiometry and without with very few contaminants. In BoLAS, the PLD technique will be used to deposit 10B-enriched neutron conversion layer on: i) Suitable substrates (membranes, carbon fiber, kapton….) to be then easily applied to existing charge-particles detectors, like silicon detectors, scintillators; ii) directly on existing charge particles detectors, like scintillation fibers; iii) directly on heterostructures of thin superconductor films. The possibility to detect neutrons using heterostructures of thin superconductor films will be explored in cooperation with the researchers of the University of Manchester. To detect neutrons, heterostructures of thin superconductor films and ^{10}B can be used. Indeed, multilayers of ^{10}B and suitable superconductor can detect neutrons in ^{10}B layer through the reaction $n+^{10}B \rightarrow a+^{7}Li+2.8MeV$. At the same time, the produced a particle can suppress superconductivity in a superconductor film nearby leading to a voltage signal that would provide the evidence of an incident neutron.



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