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Experimental set-up for thermal resistance at interface measurements

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To increase the production yield of radioisotope of medical interest, elevated particle currents are required. This is associated with elevated thermal power that should be dissipated by appropriate cooling system. The conventional solid cyclotron target for medical radioisotope production is cooled with circulating water from the back and helium gas turbulent flow from the front (optional). The water cooling system can be of two types: open circuit, when the water is in direct contact with the backing plate of the target, and closed circuit, when heat exchange is realized through the contact between the backing plate and water-cooling chamber. The closed circuit approach is providing easy target manipulation and less problem with activated water, but is limited by the thermal resistance at the interface. Several models in order to predict the thermal resistance were developed but they are not in agreement with each other and not proved by experiments.
During current study, an experimental set-up was developed in order to measure the thermal resistance at the interface between different materials in respect to the quality of the contact.
The first measurements of the thermal resistance at interface between two copper samples in respect to the contact pressure were realized. The thermal resistance at interface of copper with standard lathe machining is at the range of 7E-05 K·m2/W for 1.3 MPa and 4E-05 K·m2/W for 4.2 MPa in the contact. In future other parameters influencing the performance of the heat exchange, will be tested, such as the aging (the oxidation level of the samples), the roughness of the surface in contact and different materials. These results will help to define the concept for the high power target station for 70 MeV cyclotron at LNL-INFN.

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