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Design of scalable vacuum pump to validate sintered getter technology for future NBI application

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The vacuum systems of neutral beam injectors have very demanding requirements in terms of gas type, pumping speed and throughput. Due to its high affinity to hydrogenic species, non-evaporable getter (NEG) is in principle a good pumping technology candidate for the deployment in neutral beams, which require the injection of a serious amount of hydrogen in order to operate. Getter materials operate at room temperature, and their use could be particularly welcome in the absence of cryogenic supplies, if high temperature superconducting magnets are successfully deployed in future fusion plants. In the past NEGs have not be used due to their insufficient capacity, but with the new materials developed in recent years, a big step forward has been done.The strategy to validate the use of getter pump technology is based on the realization of a relatively large pump mock-up that has to be tested in fusion-relevant conditions. The objectives of this mock-up are to demonstrate that a pump of large dimensions and capacity is usable. This paper deals with the design of the mock-up, based on conceptual studies which involve at first 3D gas flow simulations considering different modular mock-up pumps based on NEG sintered disks. In addition transient thermal simulations with FE method have been performed with the aim to analyze the thermal response of the mock-up. The conceptual design has been carried out in order to define the best configuration to obtain high pumping speed with low spatial gradient of gas concentration inside the getter material. The suggested solution will exhibit a modular structure of getter disks, which on one hand simplifies the mechanical assembling, and on the other hand allows interpretative modelling at different scales. It is foreseen to test the pump mockup in the TIMO facility at KIT Karlsruhe.

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