Possible applications of tungsten materials in power production and future large-scale projects

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Abstract

For future nuclear fusion reactors tungsten materials are considered as the main candidates for the so-called divertor armour. For this application several hundred thousand tiles are needed to cover a surface of about 200 m². Due to the impact of high energetic particles, the erosion rate necessitates the replacement after two full-power years. The structure of the underlying cooling system strongly depends on the coolant and operating temperature. There are at least two concepts where tungsten and tungsten composite materials could come in to play. A possible spin-off from this nuclear fusion material development could lead to high temperature applications in furnaces and solar energy production as well as in chemical process technologies. For the European Spallation Source (ESS) there is a conceptual design which uses a helium-cooled rotating tungsten wheel (with a diameter of 2.5 m) as the target for a proton beam. It consists of several hundred slabs of various geometries. This paper reviews the current development status of new tungsten materials, their fabrication routes, and addresses problems which still need a solution.