Preparation of ultrafine nanofibrous uranium oxides by electrospinning

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We are introducing for the first time a robust method for the preparation and production of uranium oxide nanofibers with extraordinary thin diameters. We have studied preparation of U_3O_8 and UO_2 nanofibers, from uranyl acetylacetonate, which is soluble in organic solvents and suitable for facile electrospinning process. Polyvinylpyrrolidone was used as a supporting polymer. Beside studying and optimizing the precursor solution systems, we have examined also effects of collecting material on the properties of the fiber mat. We have found that calcination of electrospun composite fibers deposited on aluminum foil produces very thin fibers of U_3O_8 due to the prevention of nanofiber shrinking. We have studied also calcination on ash-less paper and calcination of freestanding composite mats for identifying the best possible supporting material, however aluminum foil was found as the most viable due to thinning effect on average diameter of calcined nanofibers. Reduction of U_3O_8 fibers in H_2/N_2 atmosphere provided depending on used temperature mixtures of U_3O_8 and UO_2 ultimately leading to fully reduced product UO_2. Obtained average diameters of reduced fibers were close to 100 nm and in many cases with a wide distribution of sizes where also ultrathin nanofibers around 10-20 nm were observed. Electrospinning is a widespread method which can be also extended to industrial scale therefore the resulting materials may represent a useful addition to the family of nanocrystalline uranium oxides which could be used in nuclear industry or as heterogenous catalysts.

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