MAFF Fission Target Development

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In order to provide the required fission rate of 10^{14} s^{-1} the MAFF target is designed to consist of 1 g ^{235}U dispersed in a porous carbon matrix in form of UC_2. The carbon matrix has the shape of a cylinder of 15 mm diam. and 60 mm length with a single ended central channel of 5 mm diam and 55 mm length. The fission heat leads to an average target temperature of 2400 °C during operation. To avoid local heat spikes, the fission material has to be dispersed homogeneously in th carbon.

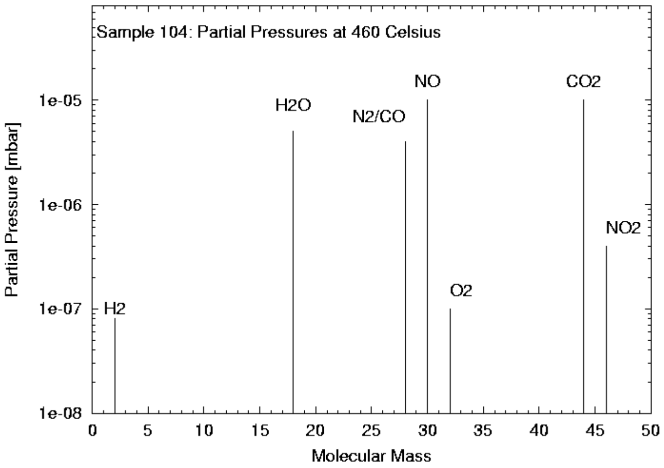


Fig. 1: Residual gas spectrum showing reaction gases NO_x

Following the procedure outlined in [1], doping of a carbon sample with uranium is performed by immersion in a saturated solution of $UO_2(NO_3)_2$ containing 343 mg of U per cm^3 of solution. Subsequent heating in vacuo up to 600 °C converts the absorbed $UO_2(NO_3)_2$ into UO_2. This reaction is completed, when the evolvation of NO_x comes to an end, which is monitored by means of a residual gas analyzer. From the weight of the sample at this stage of the procedure the quantity of U precipitated in the matrix can be determined with good approximation. Further baking at 1500 °C leads to the formation of UC_2. A typical residual gas spectrum taken at 460 °C, where the NO_x evolvation is at its maximum, is shown in fig.1.

So far four different types of carbon have been tested for their capacity of absorption of U. The results are compiled in table 1.

Carbon Type/ Supplier	% Open Porosity	mg U in Carbon	at.% U in Carbon
MKLN/SGL	20	613	0.19
R7141H/SGL	18	580	0.20
CBY/UCAR	21	586	0.18
Foam/POCO	58	1313	2.55

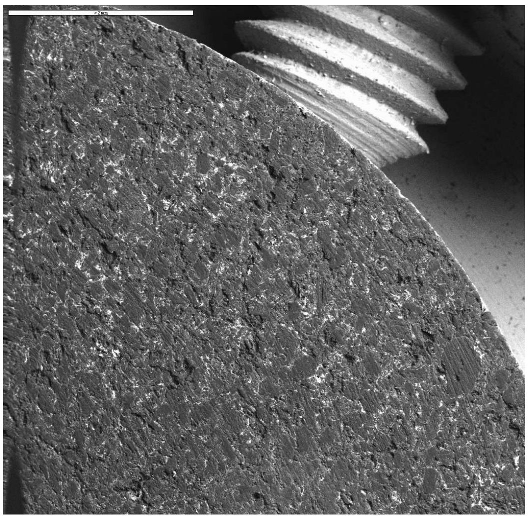
Three of the tested samples were made from traditional carbon of good mechanical strength. The last one consisted of a recently developed soft carbon foam, which can be cut with a knife, but nevertheless has a good thermal conductivity. More than the required quantity of 1 g U could be precipitated in the carbon foam, which has an open porosity of 58 %. As expected, the capacity of the traditional carbon samples is inferior, according to their lower porosity.

The homogeneity of the U dispersion in the carbon matrices differs from sample to sample, as shown in fig.2. So far, the best results were received with the sample MKLN.

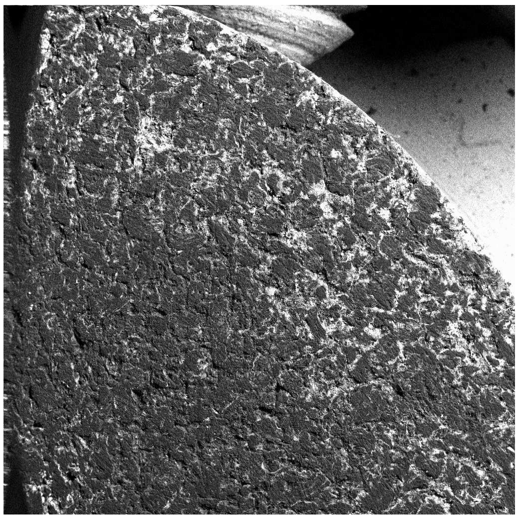
The investigations will be continued with other carbon samples of different porosities.

References

[1] H. J. Maier *et al.*, Jahresbericht 1999, p. 110



Sample MKLN



Sample R7141H

Fig. 2: SEM micrographs showing the dispersion of U in two different carbon samples. The white points represent the U deposit in the black carbon matrix.