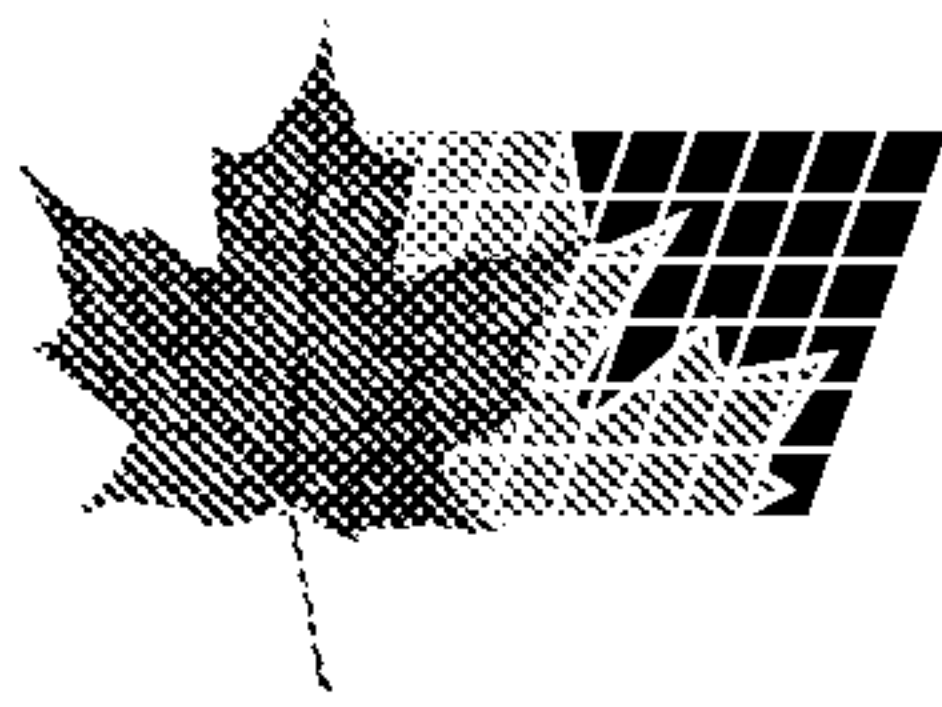




(11) (21) (C) **2,024,328**
(22) 1990/08/30
(43) 1991/03/07
(45) 2000/06/20

(72) Wood, Geoffrey Alan, GB

(73) British Nuclear Fuels plc, GB

(51) Int.Cl.⁵ G21C 3/62, C01G 43/025, C01G 57/00

(30) 1989/09/06 (8920112.3) GB

(54) **CORPS DE COMBUSTIBLE NUCLEAIRE; METHODE
D'ELABORATION**

(54) **NUCLEAR FUEL BODIES AND THE PRODUCTION THEREOF**

(57) A nuclear fuel body provided by doped uranium dioxide grains having kernels of undoped uranium dioxide. The body is produced by mixing single crystal seeds of uranium dioxide with doped uranium dioxide granules. The mixture is compacted and subsequently sintered. Gadolinia is a preferred dopant for the uranium dioxide.



Abstract of the DisclosureNuclear Fuel Bodies and the Production thereof

A nuclear fuel body provided by doped uranium dioxide grains having kernels of undoped uranium dioxide.

5 The body is produced by mixing single crystal seeds of uranium dioxide with doped uranium dioxide granules. The mixture is compacted and subsequently sintered.

Gadolinia is a preferred dopant for the uranium dioxide.

10 30737

15

20

25

Nuclear Fuel Bodies and the Production thereof

This invention relates to nuclear fuel bodies and the production thereof.

5 According to one aspect, the invention provides a nuclear fuel body comprising doped uranium dioxide grains having kernels comprising undoped uranium dioxide.

10 According to another aspect of the invention, there is provided a method of producing a nuclear fuel body, the method comprising mixing single crystal seeds of uranium dioxide with granules comprising doped uranium dioxide, compacting the mixed seeds and granules, and sintering the compacted mixed seeds and granules.

15 Preferably, the doped uranium dioxide comprises $\text{UO}_2\text{-Gd}_2\text{O}_3$. An effect of the seed particles is to nucleate grain growth of the $\text{UO}_2\text{-Gd}_2\text{O}_3$.

Preferably, the sintering is performed in an environment comprising a reducing atmosphere.

20 The invention also includes a nuclear fuel body made by the method of the invention.

25 In one example of the invention, single crystal UO_2 seeds were obtained by the method described in European Patent Application No. 88309519 and were added to UO_2 granules containing 8w/o (% by weight of) gadolinia. The seeds were mixed with the granules by stirring before being pressed into a body at approximately 4t.cm^{-2} , the seed content being approximately 2% by weight. The seeded body was sintered in an atmosphere of wet hydrogen/nitrogen for 12 hours at

1720°C. The sintered body was subsequently examined with the results as follows:

Density - 98.3% theoretical density (TD)

average grain size (unseeded) - ~ 38.6 microns

5 average grain size (seeded) - ~ 100 microns

The seeds were found to have grown during sintering resulting in the unique microstructural feature of a gadolinia-free seed located at the centre of a $\text{UO}_2\text{-Gd}_2\text{O}_3$ grain. The UO_2 seed crystals had successfully nucleated grain growth in the $\text{UO}_2\text{-Gd}_2\text{O}_3$.

10 The UO_2 in the $\text{UO}_2\text{-Gd}_2\text{O}_3$ powder is preferably derived from the reaction of uranium hexafluoride with steam and hydrogen. See also British Patents Nos 1320137 and 2064503 (United States Patents Nos 3845193 and 15 4397824). Reference is also made to British Patent No. 2177249 for further information on the use of seed crystals in nuclear bodies.

It will be appreciated that the sintering may be performed in an alternative atmosphere such as carbon dioxide.

Although a 2 w/o seed content has been described, other contents such as 5 w/o may be used.

25 30737

Claims

1. A nuclear fuel body comprising doped uranium dioxide grains having kernels comprising undoped uranium dioxide.
2. A nuclear fuel body as claimed in Claim 1, wherein
5 the doped uranium dioxide comprises $\text{UO}_2\text{-Gd}_2\text{O}_3$.
3. A nuclear fuel body as claimed in Claim 2, wherein the grains have an average size of about 100 microns.
4. A nuclear fuel body as claimed in Claim 2 or Claim 3, wherein the Gd_2O_3 comprises about 8% by weight of the
10 doped uranium dioxide.
5. A method of producing a nuclear fuel body, the method comprising mixing single crystal seeds of uranium dioxide with granules comprising doped uranium dioxide, compacting the mixed seeds and granules, and sintering
15 the compacted mixed seeds and granules.
6. A method as claimed in Claim 5, wherein the doped uranium dioxide comprises $\text{UO}_2\text{-Gd}_2\text{O}_3$.
7. A method as claimed in Claim 5 or Claim 6, wherein the seeds comprise between 2 and 5% by weight of the
20 mixed seeds and granules.
8. A method as claimed in Claim 7, wherein the Gd_2O_3 comprises about 8% by weight of the $\text{UO}_2\text{-Gd}_2\text{O}_3$.
9. A method as claimed in Claim 7, wherein the sintering is performed in an environment comprising a
25 reducing atmosphere.
10. A method as claimed in Claim 9, wherein the reducing atmosphere comprises wet hydrogen/nitrogen at about 1720°C.