

[0025] FIG. 8A is a view of another cross section of the target assembly of FIG. 8 according an embodiment of the disclosure.

[0026] FIG. 9 is a cluster of target assemblies according to an embodiment of the disclosure.

[0027] FIGS. 9A-9D are views of cross sections of the cluster of FIG. 9 according to embodiments of the disclosure.

[0028] FIG. 10 is an arrangement of clusters according to an embodiment of the disclosure.

[0029] FIG. 10A is another arrangement of clusters according to another embodiment of the disclosure.

[0030] FIG. 11 is a flow diagram illustrating an example scheme for irradiating target assemblies according to an embodiment of the disclosure.

[0031] FIG. 12 is a plan view of an example reactor according to an embodiment of the disclosure.

[0032] FIG. 13 is example data acquired using the assemblies, reactors, and/or methods of the present disclosure.

[0033] FIG. 14 is example data acquired using the assemblies, reactors, and/or methods of the present disclosure.

[0034] FIG. 15 is example data acquired using the assemblies, reactors, and/or methods of the present disclosure.

DESCRIPTION

[0035] This disclosure is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws “to promote the progress of science and useful arts” (Article 1, Section 8).

[0036] The assemblies, reactors and/or methods of the present disclosure will be described with reference to FIGS. 1-15. Referring to FIGS. 1A and 1B, an example target assembly 10 is shown. Target assembly 10 can include a uranium-comprising annulus 14. The annulus can define an outer diameter 15 and an inner diameter 17. The inner diameter can define a volume 19 within annulus 14. According to example implementations, annulus 14 can comprise less than about 20% enrichment of ²³⁵U. In accordance with other embodiments, annulus 14 can include an alloy of uranium and erbium, for example. According to another embodiment, annulus 14 can comprise uranium-zirconium alloys (UZr) and/or uranium-zirconium-hydride (UZrH_x).

[0037] In accordance with example implementations shown in FIGS. 1A, 1B, and in FIGS. 2A and 2B, the annulus may have at least one cross section. The distance between inner diameter 17 and outer diameter 15 may range from about 100 μm to about 1 cm in one cross section. In accordance with example implementations, annulus 14 can define a length extending between opposing openings to volume 19. This length can range from 0.5 to 50 cm. In accordance with example embodiments, the length can be greater than 1 cm and/or less than 38 cm, for example.

[0038] Assembly 10 can also include a target material 12 that may be received within volume 19 of annulus 14. Target material 12 can consist essentially of non-uranium-comprising material. Material 12 can “consist essentially of” non-uranium-comprising material when, the material contains uranium, if at all, it is contained in such insubstantial amounts that the uranium does not require removal from the target material, and/or does not provide decay products that require removal from the target material. Non-uranium-comprising material may also be material requiring no special uranium related radiological or health physics protocols for handling or for transporting the material; such as safety and/or disposal procedures. Accordingly, material 12 may contain inconsequential amounts of uranium and/or consist of non-uranium-

comprising material. In accordance with example implementations, material 12 can include at least one of Mo, P, S, Ir, Au, Re, and/or Cr. Material 12 can have a diameter less than about 10 cm or more specifically a diameter from about 500 micron to about 5 cm; Material 12 can also have a length of about 3 cm; and multiple discrete target materials can be engaged within volume 19 of annulus 14. For example, annulus 14 may have a length of about 38 cm and material and/or materials 12 may occupy all or a portion of volume 19 of that length. In accordance with example implementations, material 12 may occupy a terminal 12.7 to 15 cm of the length of annulus 14; accordingly this can include the bottom 12.7 to 15 cm of the length of annulus 14, for example.

[0039] One or both of target material 12 and/or annulus 14 can include cladding 16 extending entirely or at least partially over any or all surfaces. The cladding can include Zr, zircalloy and/or stainless steel, for example. Material 12 can be configured to be removeably coupled to annulus 14.

[0040] Referring to FIGS. 2A and 2B, target assembly 20 is shown in accordance with another embodiment. In accordance with example implementations, assembly 20 can include target material 12 as well as annulus 14. However, in between target material 12 and annulus 14 can be a liner 22. This liner can be associated with the inner diameter of annulus 14, for example. The liner can comprise boron, boron carbide, boron nitride, and/or cadmium, for example. Liner 22 can be commensurate in length with the length of target material 12 and/or may be commensurate in length with the length of the inner diameter of annulus 14, for example. An example thickness of liner 22 comprised of cadmium can be 390 micro-meters thick but may be as thick as about 5 centimeter. In accordance with example implementations, target material 12, liner 22 and/or annulus 14 may be configured to slidably engage one another to form a portion or all of target assembly 20.

[0041] Referring next to FIGS. 3A and 3B, a target assembly 30 is shown that includes target material 12, liner 22, annulus 14 and reflector 32. Reflector 32 can include beryllium or lead. In accordance with example implementations, reflector 32 may also include a mixture of beryllium and/or lead with other compositions such as graphite, for example. Reflector 32 may have a cross section that defines a thickness less than about 5 cm, for example, and it may be configured as one or more components that are arranged along a perimeter of the target material and/or annulus. In accordance with example implementations, reflector 32 may have a 0.16 cm thickness with an inner radius of 1.74 cm in one cross section.

[0042] Referring to FIGS. 4 and 4A, target assembly 42 is shown in accordance with another embodiment. FIG. 4 represents at least one cross section of target assembly 42 and FIG. 4A represents a transverse cross section of target assembly 42 as well. Accordingly, a volume within annulus 14 is defined in at least one cross section. Target material 12 can occupy an entirety of the volume defined in this cross section. Assembly 42 can include additional components, such as cladding, liners, and/or reflectors. In accordance with example implementations, material 12 can occupy an entirety of the volume defined in the cross section inclusive of these additional materials. For example, where assembly 42 includes liner 22, a volume is defined in the one cross section and material 12 can occupy an entirety of this volume.

[0043] In accordance with example implementations, target assembly 42 can be configured as a can. As such, target assembly 42 can include a can wall 44 that may include