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Production of high specific activity 51Cr by chromium-based metal-organic frameworks and the Szilard-Chalmers effect

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Chromium-51 (51Cr) is an attractive radionuclide in the clinical application for labelling of red blood cells, diagnosis of gastrointestinal bleeding and assessing life span of red cells. This work reports that synthesis of two chromium based metal-organic frameworks (MOFs) as radiation targets to produce high specific activity 51Cr production utilizing the Szilard-Chalmers effect. First, the radiation stability of two MOFs under high gamma doses was determined. The results showed that MIL-100 (Cr) and MIL-101 (Cr) exhibited excellent radiation stability after exposure to gamma radiation dose of 4 MGy. However, MIL-101 (Cr) started decomposing with increasing gamma dose, while MIL-100 (Cr) still kept a stable crystal structure at even higher radiation dose. Subsequently the Cr-MOFs were irradiated in the HOR reactor of the Reactor Institute Delft. The 51Cr yield and specific activity was determined at different irradiation time, extracting agents, extraction time and temperature. The most optimal results show that high enrichment factor (>500) and yield (>40%) can be achieved, appearing a promising 51Cr production routes for nuclear medicine.

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