Separation of Hydrogen Isotopes by Palladium Alloy Membranes Separator

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Separation of hydrogen isotope with palladium alloy membranes is one of the promising methods for hydrogen isotope separation. It has several advantages, such as high separation efficiency, smaller tritium inventory, simple separation device, etc. Limited by the manufacture of membrane and cost of gas transportation pump, this method is still at the stage of conceptual study. The relationship between separation factors and temperatures, feed gas components, split ratios have not been researched in detail, and the calculated results of cascade separation have not been validated with experimental data. In this thesis, a palladium alloy membrane separator was designed to further study its separation performance between H\textsubscript{2} and D\textsubscript{2}.

The separation factor of the single stage was affected by the temperature, the feed gas component, the split ratio and the gas flow rate, etc. The experimental results showed that the H\textsubscript{2}-D\textsubscript{2} separation factor decreased with the increasing of temperature. On the temperature from 573K to 773 K, when the feed rate was 5L/min, the separation factor of 66.2%H\textsubscript{2} - 33.8%D\textsubscript{2} decreased from 2.09 to 1.85 when the split ratio was 0.1 and from 1.74 to 1.52 when the split ratio was 0.2. The separation factor also decreased with the increasing of split ratio. At 573K and the feed rate of 5L/min, the separation factor of 15.0%H\textsubscript{2} and 85.0%D\textsubscript{2} decreased from 2.43 to 1.35 with the increasing of split ratio from 0.050 to 0.534, and for 66.2%H\textsubscript{2}-33.8%D\textsubscript{2}, the separation factor decreased from 2.87 to 1.30 with the increasing of split ratio from 0.050 to 0.688. When the separation factor was the biggest, the flow rate of feed gas was in a perfect value. To gain a best separation performance, perfect flow rate, lower temperature and reflux ratio should be chosen.

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