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Deuterium Permeation Though Candidates Structural Materials For a Fusion Reactor

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In the next step fusion devices high neutron fluxes and fluencies are expected. The most promising structural materials are ferritic-martensitic steels, vanadium alloys and silicon carbides.
The gas-driven permeation (GDP) and plasma-driven permeation (PDP) through Russian types ferritic-martensitic steel RUSFER-EK-181 (Fe-12Cr-2W-V-Ta-BC), austenitic steel ChS-68 and V-4Ti-4Cr were investigated.
At GDP permeability coefficient of V-4Cr-4Ti membrane is about 4 orders of magnitude higher than that of RUSFER-EK-181 while permeability coefficient of ChS-68 is higher than permeability coefficient of RUSFER-EK-181 at all pressures and temperatures.

Austenitic steel ChS-68 and **RAFMS** RUSFER-EK-181 are both acceptable as a structural material for a fusion reactor. RAFMS is preferable for a fusion reactors with a high neutron load to structural materials due to low-activated properties and low swelling under neutron irradiation. This steel seems only feasible structural material for a commercial hybrid fusion-fission reactor. Austenitic steel (such as ChS-68) preferred for use as structural material in demonstration hybrid reactor (DEMO-FNS) with expected radiation damage up to 20-50 dpa. **Vanadium alloy** is exceptionable to use as a structural material for a fusion reactor due to extremely high hydrogen permeability. However V-Cr-Ti alloys are promising materials due to compatibility with liquid lithium.