Fusion-based hydrogen production reactor (FDS-III), one of the series of fusion system design concepts developed in China, is designated to exploit the fusion energy advanced application for the production of hydrogen. Besides the parameter design of fusion plasma core, an innovative high temperature liquid lithium-lead blanket (HTL) concept based on the Reduced Activation Ferritic / Martensitic steel (RAFM) as the structural material is proposed as an option of the blanket concepts for FDS-III. The multilayer flow channel inserts (MFCIs) have been adopted in the liquid metal LiPb channels to obtain high outlet temperature of about 1000°C to satisfy the requirement for high efficiency production of hydrogen. The proper selection for its materials are key issues for the hydrogen production system, such as plasma facing material, structural material, flow channel inserts (FCIs) material for reducing magnetohydrodynamic (MHD) effects and increasing the outlet temperature of coolant, coating material for reducing tritium permeation into blanket materials and corrosion of the structural material under elevated temperature etc.. This paper gives the preliminary selection analyses for the materials concerned in FDS-III. The existing material technology bases are assessed and the further R&D needs are specified considering the special requirement for elevated temperature.

**Key words**: Hydrogen production reactor; High temperature blanket; Material selection