Recent accomplishments and future prospects of materials R & D in Japan

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After more than two decades of the intensive research activities on fusion engineering at Universities and JAERI, these activities have been unified under the management of the ministry of education, culture, sports, science and technology (MEXT) with the emphasis on fusion materials and blanket engineering.

To meet the definition of fusion reactor materials R & D, three categories of structural materials have been studied, those are; reduced activation martensitic/ferritic steels (RAFs), vanadium alloys and SiC/SiC composite materials. The R & D histories of these candidate materials and the present status will be reviewed with the emphasis on materials behavior under radiation damage.

The present status of RAFs is the most matured and the representing RAFs for fusion application, such as F82H and JLF-1, have been studied even under the IEA working group activities for more than ten years and are almost ready to be used to near term plasma devices or ITER test modules.

Significant progress has been made recently in fabrication and welding technology, applicable to industrial scale manufacturing, for V-4Cr-4Ti alloys by improved control of interstitial impurities. Recent efforts are focused on MHD insulator coating development as a key issue for vanadium alloy/liquid lithium blanket. Development of advanced vanadium alloys by minor addition of Y, Al and Si is also in progress for improved radiation and oxidation resistance.

The materials R & D methodology has been quite unique for the case of SiC/SiC and the typical example of the process development is emphasized. Such as, CVI methods and NITE process, where near near stoichiometry fibers and matrices were employed to provide excellent total performance. The recent extensive activities trying to make real size reactor components will be also presented. These results are encouraging to make attractive fusion reactors, satisfies 3E requirement, utilizing SiC/SiC composites as major structural materials.

Based on the progresses in structural materials R & D, JUPITER-II, the phase-4 of the Japan/USA collaboration on fusion materials research, has been initiated since April 1, 2001. This is the integration activity of blanket and materials engineering, where self cooled liquid blanket and He-gas cooled solid blanket systems are of concern. The brief introduction of JUPITER-II program, together with the JAERI/DOE Phase-4 collaboration on neutron radiation effect study on RAFs, will be presented.