# PHASE FORMATION IN THE THIN-LAYER SYSTEM BETI

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Progress in development of fusion reactor is slowed down by selection of materials for those reactor units, its vessel and, particularly, its first wall which are to sustain impacts from both fusion plasma and thermofor as well as radiation from the blanket.

Beryllium and titanium are considered as materials promising for the first wall.

Advantages of beryllium: lightweight, durability, hardness, high heat capacity, heat resistance, low absorption of γ-radiation, small effective section for thermal neutron capture. Disadvantages include brittleness, toxicity, tendency to cracking formation, low processibility, and easy oxidation at low vacuum, diffusivity lower than that of stainless steel or aluminum.

Titanium effectively absorbs γ-radiation, is durable and lightweight. Titanium diffusivity is for more than two times lower than that of beryllium; it is chemically and corrosion resistant in many aggressive media. Among its disadvantages are the tendency to form hydrides at interaction with hydrogen and, as a consequence, the material becomes brittle.

So, investigation of beryllium compounds formed with other metals (of so-called intermetallides) is of interest. Intermetallides represent a unique class of materials which preserve their structure and hardness at high temperatures, have high modulus of elasticity, stability to oxidation and excellent nuclear properties. For example, the intermetallides $ZrBe_{13}$ and $NbBe_{12}$ do not loose hardness and do not show swelling at fluencies up to $10^{12}$ n/cm$^2$ while swelling of $TiBe_{12}$ at 500°C is 12 times lower than that of pure Be.

In present work we aimed at production and studied a new beryllium- and titanium-based material resistant for formation hydrides and carbides in the temperature range 300-600°C.

First, we studied with high-temperature radiography 3 types of Be-Ti samples with different contents of Be; the samples were produced by magnetron sputtering over polycor and over copper substrate.

In x-ray diffractometry of samples at temperatures above room temperature we used a high-temperature vacuum chamber in the diffractometer D8 ADVANCE with tantalum band heater maximal temperature 1400°C.

The samples were annealed in $3 \cdot 10^{-5}$ torr vacuum in the temperature range from room temp.

to 1400°C with the step 100°C and exposure at each temperature point for 1 hour. Upon ageing the diffraction images were taken and temperature reduced to the room level; then, diffraction images were taken again.

Influence of vacuum annealing on structure and phase state of the produced composition coatings over polycor revealed crystallization of α-Ti at 500°C and stabilization of Be solid solution in α-Ti; at 800°C there was registered stabilization of solid solution of Be in β-Ti in the first sample Be-Ti-1p (27.4 at. % of Be).

This was not observed for the sample Be-Ti-3п (71 at. % Be).

In order to form solid solution of Be in α- and β- alloys of Ti was performed high-temperature treatment of Be-Ti coatings over various substrates; optimal temperature regimes for creation of the intermetallide BeTi were also identified.

The paper presents outcomes of the complex investigation of hydration in Be-Ti system sputtered over copper substrate subjected to thermal treatment in hydrogen medium.

Pilot samples with metastable titanium beryllide layers BeTi and $Be_2Ti$ over titanium foil substrate of various thicknesses were obtained using diffusion at thermal treatment in vacuum.

Reconstruction studies showed that the titanium beryllide coatings do prevent carbidisation of the titanium substrate.

This information has practical value for creation of coatings and protection of materials from hydrogenation and carbidization. The data should contribute to the development of new construction materials for nuclear and fusion technology.