Boride targets for improved coating materials

In conjunction with Oerlikon Surface Solutions AG and the Institute of Materials Science and Technology at the Vienna University of Technology, Plansee Composite Materials GmbH is carrying out research into improved coating materials at one of the Christian Doppler Laboratories.

Boride targets, from the top left: CrB₂, TaB₂, VB₂, TiB₂, ZrB₂, Nb₂, and W₂B₅

Protective coatings are subject to extremely high demands. After all, their job is to increase the efficiency, usability and service life of precision components. This includes items such as cutting tools, turbine blades and valves in the automotive industry. An intensive program of research into new, tailored coating materials is underway in order to meet these demanding requirements. Coatings based on borides are showing considerable promise. They have a wide field of application and are used as ultra-high-temperature resistant wear and erosion protection coatings, oxidation barriers or thermal barrier coatings, for instance. But a considerable amount of research is still required, as
more knowledge is needed about boride-based coating materials if they are to be used more widely. This is why Plansee Composite Materials GmbH is carrying out research into the ternary diborides in conjunction with Oerlikon Surface Solutions AG and the Institute of Materials Science and Technology at the Vienna University of Technology. The research involves selecting combinations of diborides and depositing them experimentally to form ternary systems. This involves a co-sputtering process using ultra-pure diboride targets from Plansee Composite Materials GmbH, with materials such as CrB2, TaB2, VB2, TiB2, ZrB2, NB2, and W2B5. This covers a wide variety of chemical composition of the coatings and allows their properties to be investigated.

Coatings made up of W1-xTaxB2 are proving promising. The addition of up to 26 at % tantalum to the preferred α crystal structure of WB2 increases the thermal stability from 800 °C up to 1400 °C. The research team around Paul Mayrhofer and Helmut Riedl were able to provide theoretical and empirical evidence that this effect is based on vacancy stabilization of the crystalline structure. The team also proved in various publications that the addition of tantalum did not have any negative impact on the extremely high fracture toughness of α-WB2. This is fundamentally important, since it has not yet been possible to find applications for most diborides on account of their brittleness. On the basis of these research findings, Vincent Moraes, a PhD student in the research team at the Vienna University of Technology, was presented with the Gold Metal Award at the international ICMCTF conference in April 2018.

You will be able to find out more about ternary borides in September at the 83rd IUVSTA Workshop in Vadstena, Schweden.