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Deposition of Ti3SiC2-thin films by HIPIMS on stainless steel foils

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Today a lot of research is done on replacing compound bipolar plates in hydrogen fuel cells by metallic ones to make them smaller and cheaper and thus suitable for more applications. Using metallic bipolar plates poses two major demands: Obtaining a low contact resistance and a long lasting corrosion protection in the fuel cell environment. In literature, different surface treatments and thin coatings are tested. In this work an attempt has been made to deposit Ti_3SiC_2 MAX-phase coatings by Magnetron sputtering on stainless steel foil which metallic bipolar plates are produced of.
Following the path gone by other research groups, the first step was to deposit a TiC seed layer with (111) orientation. This could be realised by dc-Magnetron sputtering (dc-MS) even for substrate temperatures as low as 200°C.
The next step was gaining the appropriate Ti_3SiC_2 stoichiometry at the substrate, which was published and found to be challenging, because with dc-MS too much C and too less Ti reaches the substrate when sputtering from a MAX-phase target.
Depositions were carried out in a special substrate holder arrangement using dc-MS and High Power Impulse Magnetron sputtering (HIPIMS) at various parameter combinations including different on- and off-times of the HIPIMS pulses. Preceding experiments including optical emission spectroscopy (OES) measurements had revealed that variations of these pulse parameters cause a great diversity of ionisations of the sputtered particles, mainly of Ti.
The depositions yielded that suitable HIPIMS parameters and a relatively high Ar-pressure do generate a film stoichiometry very close to the desired Ti_3SiC_2. This was attributed to the fact, that the ionisation of Ti is much stronger then for C.
X-ray diffraction (XRD) and transmission electron microscopy (TEM) investigations on stainless steel samples prepared at high temperatures (about 900 °C) gave first indications of MAX-phase nucleation.

Keywords
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