electrolysis and the fuel cell operation can be performed with the same system and the same stack. The system is operated up to now for about 6,700 h. In fuel cell mode a maximum DC system efficiency of 62% could be demonstrated at a stack power of 5.3 kW. The system's DC efficiency in electrolysis operation at 14.3 kW_{DC} was 70%.
Investigations on electrolysis have mainly focused on co-electrolysis. Cell and stack tests showed that the product gas composition of H_2 and CO can be very well tuned by the corresponding input composition ratio of steam to CO_2.

168 Biofabrication with composite bioinks: emerging approaches and challenges

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Biofabrication is a novel research field aiming at the development, by automatized additive manufacturing methods, hierarchical 3D structures (tissue scaffolds) applying different materials (hydrogels) and cell types. A current interest is the incorporation of bioreactive inorganic fillers, e.g. silicate nanoparticles, bioactive glasses, nanoclays, to achieve better processing capability (printability) and superior functionalities, including suitable mechanical properties, biodegradation behavior and cell biology performance. In this presentation, the field of bioafabrication using such composite bioinks will be presented, focusing on own results based on alginate dialdehyde gelatin (ADA-GEL) hydrogels incorporating different amounts of bioreactive inorganic fillers. FTIR measurements and mechanical tests were carried out, *in vitro* biocompatibility studies combined with fluorescence staining and cell viability assays will be presented to show the composite's biological behavior for tissue regeneration, with focus on the effect of the silicate filler addition. Moreover the optimization of the filler concentration on printability will be shown, considering that the release of bivalent calcium ions from the filler particles (e.g. sol-gel derived SiO_2-CaO nanoparticles) can strengthen the network of the hydrogel over time leading to a better stability after printing. Cell biology studies showed that the inorganic filler particles exert no negative influence on the cell behavior, at least under the printing conditions investigated. Overall, the development of such silicate-hydrogel composite bioinks represents a step forward in the development of suitable bioinks for biofabrication.
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169 Nickel-chromium coatings with rhenium and aluminium oxide additions deposited by HVOF technique for steam boilers application

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The corrosion and erosion processes are detrimental to the lifetime and maintenance costs of steel combustion boilers in the energy sector. One of the remedies for this problem can be novel NiCr based coatings applied on structural elements, which are exposed to aggressive agents. NiCr alloys are known for their resistance to chemical and physical degradation in high temperature. Introducing a small admixture of rhenium and alumina ceramic to NiCr results in

further increase of mechanical and wear properties of the coating. Three different deposition techniques were employed (HVOF, laser cladding and plasma spraying) to manufacture the coatings. The primary target of this research was to identify by experiments and numerical simulations the most promising deposition technique for the industrial application of the investigated coatings. Thermal residual stress measurements by XRD have shown that the lowest stresses occurred in the HVOF-deposited coating. The micro-CT based numerical simulations have confirmed this finding. The highest hardness was also manifested by the coating deposited by HVOF. The admixture of 10% vol. of Al_2O_3 has improved the coating wear resistance. Remelting of powders during the laser cladding and low wettability of alumina were the main reasons of the unwished migration of ceramic particles towards the coating surface. A non-standard adhesion test was used to examine the coatings integrity and adhesion to the substrate. The obtained results point to the HVOF technique as the most promising of the three techniques considered. Moreover, HVOF can be easily implemented for complex shapes of the components.

170 Segregation dependent adhesive properties of a Cu-WTi layered stack

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Cu is a common metallization material in integrated circuits due to its low resistivity. However, it shows a low adhesion to the dielectric layer and reacts with Si reducing the lifetime of the device. To improve the adhesion and chemical stability, an interlayer such as WTi is needed. The interfacial and mechanical properties of the Cu-WTi system have not been studied in detail and need further research.
We present results on the adhesion properties of Cu-W and of Cu-WTi layered systems. We analyze the segregation behavior of common technical elements and their effect on interface adhesion. The interfaces are based on the Kurdjumov-Sachs and Nishiyama-Wassermann orientation relationships. The adhesion of Cu-W is compared to Cu-WTi and the impact of Ti is discussed. The segregation behavior and the preferred segregation sites of common technical elements are analyzed and compared to the segregation behavior in pure Cu and W. Finally, we discuss the strengthening and weakening effect of segregants on the cohesive strength of the interface and its implications for alloying and impurities. The results contribute to an improved understanding of the cohesive properties of the Cu-WTi system, which can serve towards controlled engineering of the Cu-WTi interface to increase its mechanical stability.

171 Correlative Cross-Sectional Characterization of a Liquid Dispersed Metals Powder Bed Fused Inconel-Steel Hybrid Structure

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State-of-the-art powder-bed-based technologies provide a lot of advantages on the aspect of part's quality but have to deal with some limitations like the capability to build multi-material