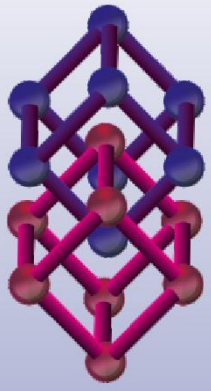

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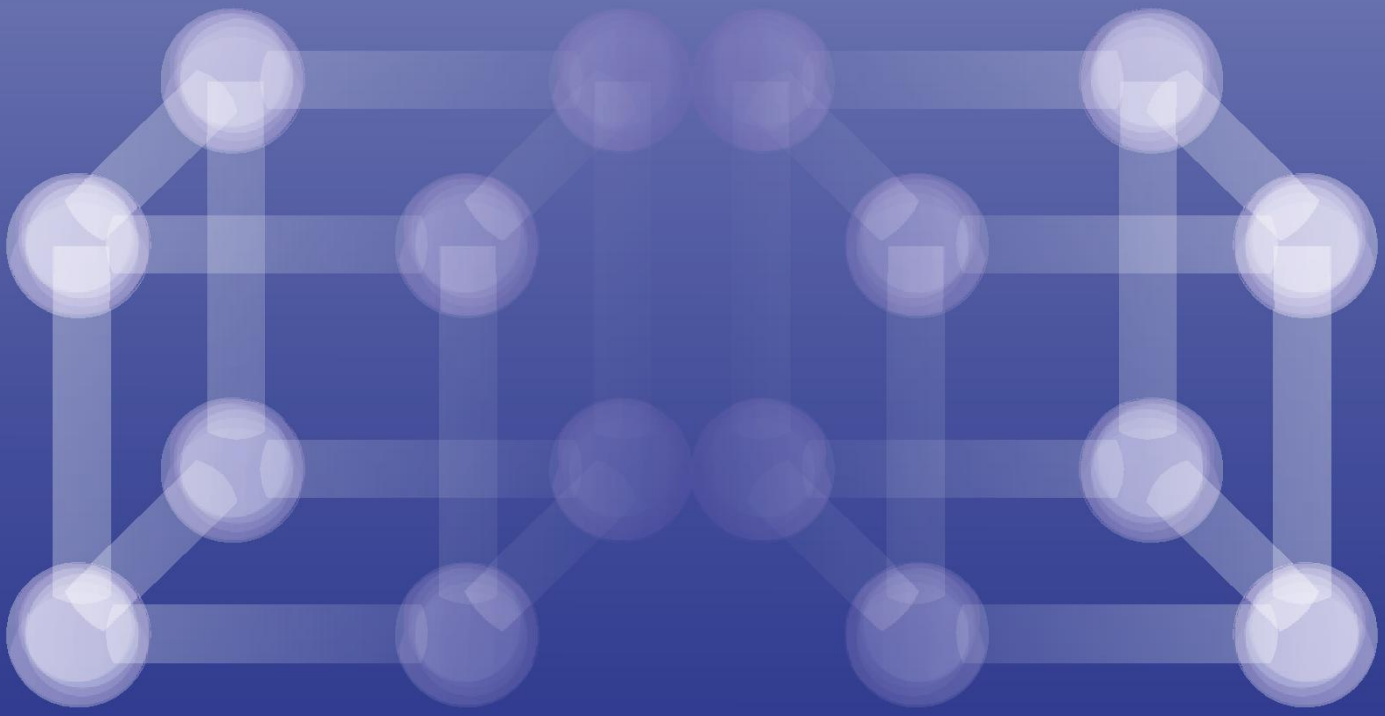

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The study of reaction products of eutectic Zr-Si melt with carbon fiber reinforced carbon precursors

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The ceramic matrix composites (CMC) are found themselves today in many different areas of applications in commercial sectors. The reactive melt infiltration (RMI) technics of CMC manufacturing are adventurous over the traditional ceramic processing methods due to low shrinkage and near-zero porosity of the final composites. The CMC manufacturing by reactive silicon melt infiltration of carbon fiber reinforced carbon (CFRC) precursors has been rather well studied and presented in the literature. However, the using of ultra-high temperature ceramics such as ZrC can improve ablation and erosion resistance of “ordinary” SiC matrix of CMC and further improve high-temperature performance. In this regard the study of the carbon fiber protection and carbide formation process as well as the reaction products in the system carbon fiber reinforced carbon – zirconium - silicon is an urgent and important task for manufacturing of Zr-Si-C-matrix composites with high performance properties.

The carbon fibers before CFRC synthesis were protected from reactive melt by polymer impregnation and pyrolysis technics using preceramic compositions based on polycarbosilane, oligovynilsilazane and rolivsan. The carbon matrix of CFRC were synthesized form resol phenol-formaldehyde resin and ethylene glycol with the using the polymerization induced phase separation step to achieve the desired porosity and transport properties. To minimize the processing temperature of RMI the eutectic Zr-Si was chosen.

It was shown that in the case of unprotected carbon fibers the Zr-enriched phases are located preferable along the perimeter of carbon fiber filaments. It was proposed that the infiltration and reaction rate in the interphase of carbon fiber and carbon matrix are higher than through the carbon matrix. The protection of carbon fibers with Si-C-N based interfacial coating allows protecting the reinforcing carbon fibers from reactive melt and undesired carbide formation.

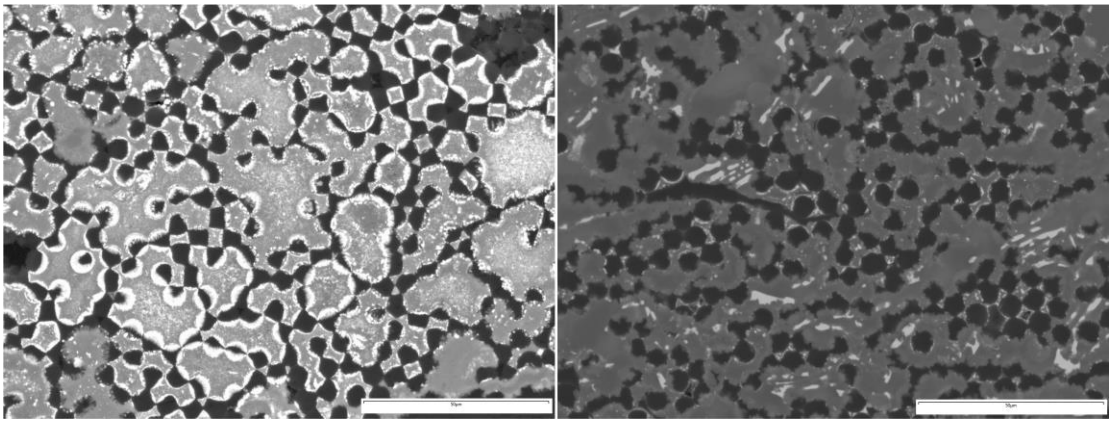

Figure 1. Microstructure of the reaction products of eutectic Zr-Si melt with CFRC based on unprotected carbon fibers (left) and protected by Si-C-N interfacial coating carbon fibers (right)

Acknowledgements

The reported study was funded by RFBR according to the research project № 17-03-01163.