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New energy-efficient technology to produce carbon fibers

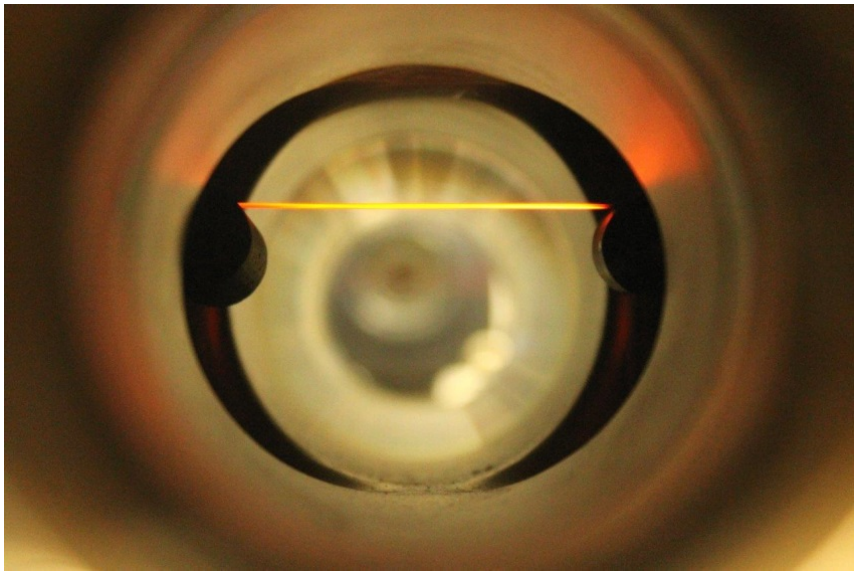
Dresden researchers of the Fraunhofer IWS and the TU Dresden have developed a new energy-efficient process chain for carbon fiber manufacturing. The approach aims at the conversion of polyacrylonitrile (PAN) procurser fibers by means of their stabilization, carbonization and graphitization. Thereby, in future it will be possible to produce carbon fibers at clearly lower costs.

Thanks to their excellent mechanical properties, carbon fibers are acknowledged worldwide as the most powerful fiber material that can be used to reinforce matrices,(e.g. thermosets, thermoplastics, concrete, as well as ceramics in lightweight design). Forecasts performed by the registered association Carbon Composites e.V. predict an ever-increasing carbon fiber demand of more than 115 thousand tons worldwide with approximately 12 percent of growth per year until 2021.

In contrast to the fabrication of metallic lightweight materials, the manufacturing of fiber composite materials with carbon fiber content is time-consuming and thus expensive. To cut costs, both the precursor material and the manufacturing costs have to be reduced. One example is that the current 24k filament yarn prize of 18 € / kg has be lowered to 10 € / kg in the field of automotive applications. One third of these costs alone result from the thermal processes, such as stabilization and carbonization.

The Fraunhofer IWS has been developing processes of the thermal surface technology, as well as plasma and laser processing technologies for decades. Different direct fiber heating techniques used to stabilize, carbonize and graphitize the fibers are currently analyzed individually and in combination one with another as an entire process as well. All procedures are benchmarked in comparison with the commercial processes in furnaces and the related limiting temperatures. A linear low pressure plasma source and a cold-wall reactor with direct fiber heating are used as an alternative heating device. Thus the carbon fibers manufactured by means of these new devices showed properties that are similar to those produced in conventional procedures.

In the next step, these excellent results will be implemented in various precursor materials, and the process parameters for each precursor material will be optimized.
Companies interested in this topic are encouraged to participate in the refinement of this technology. The technique and the related equipment were applied for a patent to protect the proprietary rights of our partner from industry.



Carbon fiber just being carbonized in the cold-wall reactor, with direct heating of fibers
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