OUR OFFER

The ComCarbon[®] technology has been developed at the Fraunhofer IAP. We provide the basics of a technology for the manufacture of cost-efficient carbon fibers via the melt-spinning route.

We offer the related IP including patent family and know-how. We accompany the industrial implementation of the process with interested industrial partners.

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FRAUNHOFER INSTITUTE FOR APPLIED POLYMER RESEARCH IAP

ComCarbon®

A NOVEL FRAUNHOFER TECHNOLOGY FOR THE PRODUCTION OF COMMODITY CARBON FIBERS

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PRECURSOR COST REDUCTION **BY MELT-SPINNING**



CHALLENGE

Carbon fibers represent the most advanced reinforcing fiber product for extremely light weight composites in applications such as aircrafts, formula one racing cars, high-performance yachts, bicycles and many other high-end products. However, the penetration of mass markets like automotive, wind energy turbine blades, building and construction and other industries currently using glass and natural fibers remains difficult. One major reason is the high production cost of the present day carbon fibers (of at least 15 €/kg).

According to substantiated estimates, a reasonable price reduction (to around 10€/kg) could trigger the mass application of carbon fibers in these sectors. This is addressed by the ComCarbon[®] technology with the following approach.

APPROACH

About half the cost of common standard large tow carbon fibers originates from the polyacrylonitrile (PAN) precursor fiber production, mainly from the expensive solution spinning process.

With the ComCarbon[®] technology an alternative PAN-based precursor technology has been developed by the Fraunhofer IAP permitting a precursor cost reduction of 60 percent.

This new technology is based on a low-cost melt-spinning process with special PAN-copolymers patented by the Fraunhofer IAP. Precursor fibers can be processed, in principle, by existent stabilization and carbonization equipment used in established production routes. The desired optimized stabilization regime is part of the Fraunhofer technology package.

NOVEL MELT-PROCESSIBLE PAN-COPOLYMERS

PAN is an ideal precursor material for carbon fiber production. Today, precursor fibers are produced predominantly by wet-spinning of appropriate PAN-copolymers. For the less expensive melt-spinning, conventional precursor materials cannot be used due to their lack in fusibility. Meltable PAN-copolymers usually have rather large amounts of co-monomers in the order of 20 percent impairing the favorable PAN structure for the conversion into carbon fibers.

The Fraunhofer IAP has developed proprietary meltable PAN-copolymers with tailored co-monomer structure and reduced co-monomer content.

Outstanding thermal stability allows conventional multifilament melt-spinning of these PAN-copolymers. The ComCarbon[®] technology also covers the advantageous emulsion polymerization process to obtain the novel precursor polymers in an industrially viable way. The costs of the novel copolymers should not exceed the price of usual PAN precursor copolymers because all components used, i.e. monomers as well as additives, are commercially available, inexpensive substances.





MELT-SPINNING

The tremendous economic and ecologic advantage of melt-spinning over solution spinning results from a series of factors:

- First, no solvents are involved and thus, there is no need for recycling and maintaining bath concentrations and temperatures or specific solvent-related measures for health and safety at work.
- Further, spinning is performed with 100 percent concentration of the desired material with considerably higher spinning speeds, besides much lower investment costs.
- With the new PAN-copolymers, classical multifilament melt-spinning can be demonstrated at the Fraunhofer IAP on conventional spinning equipment containing single screw extruder and spinning package.
- On the pilot plant line spinning speeds of more than 1000 meters per minute were realized resulting in precursors with round cross-sections and void-free morphology as well as perfectly smooth surfaces.
- Titers can be adjusted in the usual range and the precursor can be spun as FDY or POY to allow additional post-treatment to further increase molecular orientation.

CONVERSION TO CARBON FIBERS

In order to pass the necessary stabilization and carbonization steps, the melt-spun precursor fibers have to be converted into an infusible state. This process is called pre-stabilization in the ComCarbon[®] technology set-up.

- One processing route to achieve infusibility is based on cross-linking the copolymer molecules after melt-spinning by electron beams or UV radiation.
- The other route consists in a chemical treatment splitting off non-PAN co-monomer fractions rendering the
 resulting fiber infusible and triggering the cyclization process.

Once pre-stabilized, the multifilament yarn is continuously transported and thermally treated in conventional stabilization ovens at medium temperatures and carbonized at temperatures up to 1500 °C in the present setting.

Extensive know-how concerning the new precursors and these regimes has been generated at the Fraunhofer IAP.