Original properties	Typical values
Shore A Durometer	79
Tensile strength	18.4 MPa
Elongation	205%
Color	Black
Electrical properties:	
Volume resistivity	100 Ω cm
Heat ageing, 70 h @ 250°C:	
Change in Durometer	+3 pts
Change in tensile	–20.0%
Change in elongation	+20.5%
Compression set, 22 h @ 200°C:	
	28.0% set
Fluid resistance, ASTM Fuel C, 70 h @ room temp:	
Change in Durometer	–2 pts
Change in tensile	–21.0%
Change in elongation	–1.5%
Change in volume	+2.7%
Low temperature resistance:	
Brittleness at –25°C	Pass

Table 6. Typical physical properties of nanotube-filled, high-fluorine fluorocarbon.

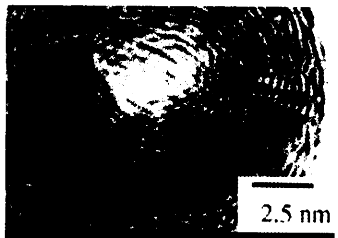

Figure 3. Transmission electron microscope image of part of a nanotube, showing the multiwall structure surrounding a hollow core.

Figure 4. Scanning electron microscope image showing the curvilinear structure of multiwall nanotubes.

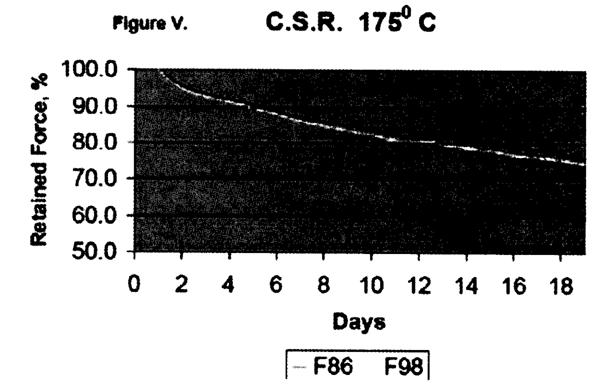

Figure 5. Compression stress relaxation measurements for two high-fluorine FKM compounds, one with mineral filler and the other with nanotubes.

better permeation performance of the nano-tube filled fluorocarbon over conductive carbon filled versions at elevated temperatures.

As for the next steps, the nanotechnology will be expanded for use in other elastomers. As better elastomers are developed, they will be utilized along with the carbon nanotubes for applications outside the standard fuel quick-connect as outlined in this feature article. Fuel lines containing fluorocarbon barrier layers will benefit, as well as other seals within the fuel system such as fuel filler cap and intake gaskets.

Users in areas outside the automotive arena have also shown immediate interest in this new technology. From semiconductor manufacturers to aerospace applications, nanotechnology within elastomers is in its infancy but growing rapidly.

Conclusions

Electrostatic dissipation FKM formulations reinforced with carbon nanotubes are a step function improvement for fuel system sealing. O-ring seals using this technology provide key advantages for softness, permeation resistance, and resistivity under stress compared to conventional technology. Nanotube-filled FKM materials also process well, and can provide good long-term sealing force retention.

Future applications are expected to include additional fuel system components, alternative elastomer compounds, and other industries such as aerospace and semiconductor manufacturing.

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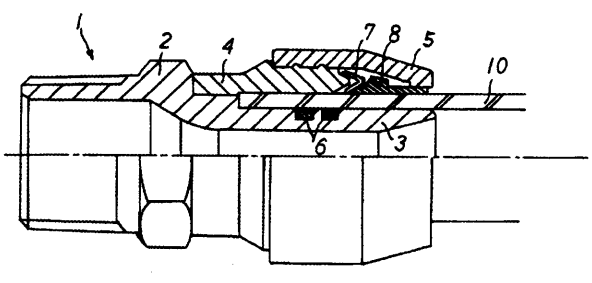
Patents

Pipe joint with viewing of complete insertion

Applicants: **Bridgestone Corporation** *and* **Bridgestone Flowtech Corporation, Japan**

This pipe joint, which has part of the joint that corresponds to the position of the head of an inserted pipe, is constructed in a transparent resin. The purpose is to enable a fitter to easily visually determine whether or not the insertion is complete. The pipe joint has a joint base body, and an inner tube extending from the joint base body which is fitted into the bore of the pipe. An O-ring is fitted in the outer diameter of the inner tube. A transparent resin collar corresponds to a head portion of the pipe completely inserted in the inner tube. It is fixed to the joint base body, and through it the head of the pipe is visible. The pipe retaining ferrule and clamping nut are fitted to the resin collar.

Patent number: WO 2005/080854
Inventors: Y. Hosoda *et al.*
Publication date: 1 September 2005



The pipe coupling described in WO 2005/080854 has a transparent collar (4), so that the fitter can check that the pipe is fully home.