Molecules delivering drugs as they walk

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An octopus-like polymer can "walk" along the wall of a narrow channel as it is pushed through by a solvent. Now research in The *Journal of Chemical Physics*, which is published by the American Institute of Physics, provides a theoretical model that compares the transport characteristics of straight- and branched-chain polymers in smooth channels as well as in channels whose walls interact with the polymer -- work that could aid in the development of carrier molecules for delivering drugs at a controlled rate in the body.

"The deformability of particles makes them very different from atoms or hard colloids," says author Arash Nikoubashman of Heinrich Heine University of Dusseldorf, Germany. "Equilibrium studies show a huge impact on the self-organization of these molecules and we wanted to know how this aspect expresses itself when the molecules are pushed around by a flowing solvent."

The researchers compared the flow of linear polymers to that of dendrimers, or regularly branched polymers. Results indicate that flow through a narrow channel is independent of the number of monomers in the polymer chain. In a smooth channel, flow is also independent of shape: the linear polymer and the dendrimer both travel in the rapid solvent flow toward the center of the channel. When patches that attract the polymer are placed on the wall, however, the dendrimer "walks" along the wall from patch to patch, while the linear polymer tends to remain close to the wall, moving very slowly, if at all, through the channel.

Possible applications of this research include an understanding to the movement of biological molecules through pores, and the development of dendritic carriers to deliver molecules at a controlled rate. Blood vessels resemble the model channel with patches of differing chemical affinities.

"At the moment we are investigating the cargo transport capabilities of dendrimers," says Nikoubashman. "Place a guest molecule, such as a drug within a dendrimer that has affinity to specific patches on the vessel wall and let it flow with the solvent." As the dendrimer docks on the patches, it may be possible to deliver the cargo to the dock while the carrier washes away with the flow.

More information: The article, "Flow-induced polymer translocation through narrow and patterned Channels" by Arash Nikoubashman and Christos Likos will appear in *The Journal of Chemical Physics*. See: jcp.aip.org/

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