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Predicting The Tube Diameter For Polymer Melts and Solutions

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A simple conjecture, relating the tube diameter to a characteristic length called the packing length, works well for all flexible entangled polymer melts. This is a remarkable result, because the tube diameter represents the confining effect of uncrossability of the chains, whereas the packing length is determined only by a chain's bulkiness and flexibility. I extend this conjecture to solutions: first for theta solvents, where it is shown to be equivalent to the Colby-Rubinstein scaling picture, and then for good solvents. In the latter case, it turns out that the number of blobs per entanglement strand is not a constant as had been previously assumed, but depends on the ratio of the packing length to the thermal blob size. Finally, I suggest that the packing length can be related to the Gauss winding number density, thus providing a topological basis for the conjecture.