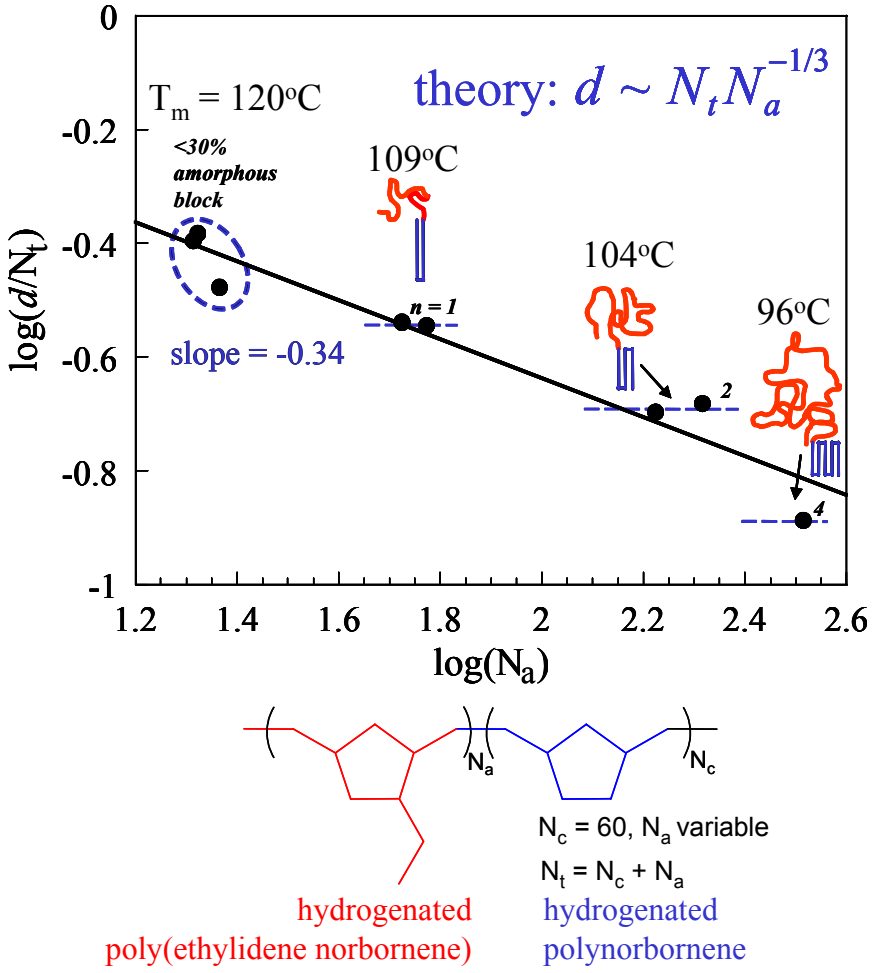
Controlled Crystallization in Novel Block Copolymers

Richard A. Register, Princeton University, DMR-0220236

The melting temperature T_m– where a material turns from solid to liquid– is a key quantity for any crystalline polymer. Thin crystals melt at lower temperatures, and polymer crystals are extremely thin: typically 10 nm, 1/10000th the thickness of a human hair. In typical polymers, the crystal thickness *t* reflects the process used to freeze the specimen, leading to variation in T_m. By attaching noncrystallizable segments (red curve, in schematics at right) to a crystallizable polymer chain (blue), we can induce the chain to spontaneously fold to a reproducible crystal thickness and intercrystal separation *d*. The number of folds *n* increases with the length of the noncrystallizable block (N_a), in good agreement with theoretical predictions. The different folded structures have different melting points as indicated, permitting precise control of T_m.



L.-B.W. Lee and R.A. Register, Macromolecules, in press (2004)

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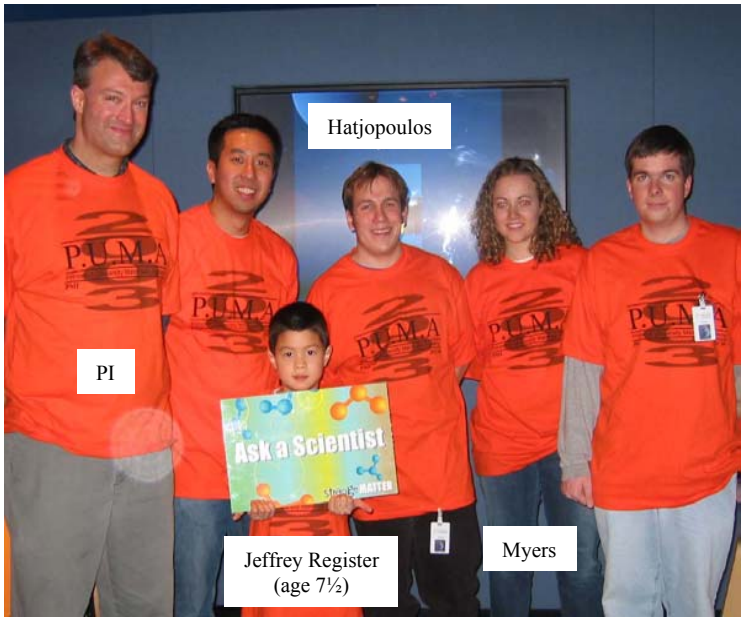
Education:

During FY04, one graduate student completed her Ph.D. (Li-Bong Lee, now at ExxonMobil), and one undergraduate completed his B.S.E. (Chinedum Enyinna). Two Ph.D. students (John Hatjopoulos and Sasha Myers) are currently engaged in this research. Two visitors also contributed to this project during FY04: Marie Ung (REU, UC-Berkeley), who investigated gels of semicrystalline block copolymers as dielectric elastomers, and Dr. Babaniyi Babatope (Senior Lecturer in Physics, Obafemi Awolowo Univ., Nigeria), studying the effect of intercrystal spacing *d* on the glass transition temperature.

Outreach:

A major outreach program for the group during FY04 was support of the traveling exhibit "Strange Matter" developed by the Materials Research Society, during its first U.S. stop at the Liberty Science Center (Jersey City, NJ).



Register Group at Liberty Science Center (Feb '04).

for more info, see
http://www.princeton.edu/~seasweb/eqnews/spring04/feature7.html