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## Discussion of paper by A. Shabbir, Q. Huang, G. Baeza, D. Vlassopoulos, Q. Chen, R. H. Colby, N. J. Alvarez and O. Hassager, entitled ‘Nonlinear shear and uniaxial extensional rheology of polyether-ester-sulfonate copolymer ionomer melts’

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**Zuwei Wang:** How many charges are there per chain? What is the average cluster size?

**Answer:** Seven charges per chain. The average cluster size is a few nanometers.

**Constantino Creton:** You said that ionomers break at stresses of the order of the plateau modulus, but acrylic acid based materials which create much weaker sticker groups break at much higher stresses relative to the plateau modulus.

**Answer:** It depends also on the strength or the activation energy of the sticker. If the physical crosslink or bond is a strong one, then diffusional mechanisms leading to dissipation in the system are somewhat restricted and the only way for the system to accommodate the stress would be to break at low stress. For this specific case, the stress is of the order of plateau modulus. But acrylic based systems do break at much higher stresses because the bonds are weak allowing for dissipative mechanisms to accommodate higher stresses during stretching.

**Costantino Creton:** Maybe weak is better than strong in this case?

**Answer:** Indeed.

**Evelyne van Ruymbeke:** Does association time decrease in the stretched state? How do you take into account this possible decrease of the association times? Does it affect your analysis based on  $Wi$  number?

**Answer:** That is a good question. Sticker life time is a notion used for equilibrium dynamics. I think that the stretched bonds break more quickly than the nonstretched ones. In the current analysis, this has not been considered. It would certainly be worth looking at for understanding the fracture mechanics of these systems.

**Salvatore Coppola:** Did you try to adjust the waiting time prior to shear? A longer time might improve adhesion of polymer to the metal surface of the tools. This can help also to avoid wall slip.

**Answer:** Annealing time of 1 h at 120 °C was used for equilibration, evaporation of any water, and to get a good contact with the plates before shearing.

**Jorge Ramirez:** Regarding slide 19 on wall slip (Fig. 4 in the paper), on the left panel, the smallest shear rates are higher than those on the right! Did you try smaller extensional rates on the sample with  $\beta = 5\%$ ?

**Answer:** Avoiding wall slip for such brittle samples is not easy. However, it could be very interesting to try and see if it persists also at low shear rates.

**Evelyne van Ruymbeke:** You said that at low  $T$  you did not see strain hardening, but if you decrease the extension rate would you see it?

**Answer:** Probably, yes. Everything is relative. If rates are lower than the reciprocal of  $Wi$  number based on sticker lifetime, one should see strain hardening. Alternatively, if you match the effective Weissenberg number of the higher  $T$  experiments at higher rates one should see strain hardening too, as shown in the paper.

**Jorge Ramirez:** For the fracture/breaking during extension, does the fracture always start at the surface, or sometimes at internal defects?

**Answer:** Yes, it looks like it always breaks from the edge, but it could be surface defects such as bubbles. This fracture is distinct from necking. Fracture in our experiments always initiates from the edge.