letters

Comments on 'Percolation model for brittle–tough transition in nylon/rubber blends'*

Margolina and Wu have proposed a percolation model for the brittle–tough transition in nylon/rubber blends, based on the interparticle distance model[1]. According to this model, tough behaviour occurs when thin ligaments, smaller than the critical interparticle distance, are interconnected, allowing the yield process to propagate and pervade over the entire matrix in the deformation zone.

PERCOLATION THRESHOLD

As in customary use, the percolation threshold refers to the onset of the 'first-path' connectivity, which is however slightly below the actual onset of tough behaviour[1].

If the percolation threshold (ϕ_{sc}) is at the onset of tough behaviour (the critical interparticle distance), ϕ_{sc} is $\pi/6$ (0.52) (ref. 1).

For the case where the actual onset is slightly below the brittle–tough transition, we expect the new ϕ_{sc} to be constant too and the value dependent on the assumed shift (not specified in the article). As this shift is arbitrary and the ϕ_{sc} is expected to be a constant in the range of the given blends, it is debatable whether any valid conclusions can be drawn from these data.

SCALING LAW

If the brittle–tough transition is a percolation phenomenon, a scaling law above the percolation threshold is expected with a value for the critical exponent g of 0.44 (ref. 1):

$$G \sim (\phi_s - \phi_{sc})^g \tag{1}$$

where G is the toughness and ϕ_s the stress volume fraction.

If the percolation threshold is in the brittle region then the region from the percolation threshold to the brittle–tough transition should also follow the scaling law[1].

The scaling law for the brittle–tough transition was evaluated by plotting the toughness data of the tough fractured samples, and the toughness in the above-mentioned brittle region was calculated with:

$$G' = G_0\phi_s \tag{2}$$

where G' is the 'tough' strength in the brittle region and

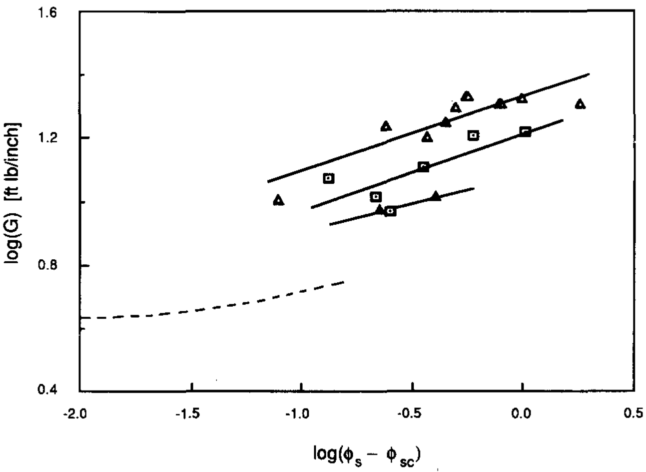

Figure 1 Log G *versus* $\log(\phi_s - \phi_{sc})$ for nylon/rubber blends. △, $\phi_r = 0.306$; □, $\phi_r = 0.189$; ▲, $\phi_r = 0.128$; ---, tough strength in the brittle region ($G' = G_0\phi_s$)

G_0 the toughness when the stress volumes just pervade over the entire deformation zone. For G_0 a value of 10 ft lb in^{-1} was given[1]. Margolina and Wu plotted all the data irrespective of the rubber concentration, although the rubber concentration has a significant effect on the toughness[1].

We drew the line(s) through the data of constant rubber concentration (for ϕ_{sc} a value of 0.42 was taken (*Figure 1*). The data of the different rubber concentrations in the tough region do not fall on the same curve and the slopes of these lines are much smaller than 0.44. For the tough data in the brittle region a curve is constructed using equation (2). The calculated brittle region data are not in line with any of the tough region data. From this figure it is clear that the scaling law does not hold for the tough data above the percolation threshold.

CONCLUSION

With the given data, no indication is obtained that the proposed percolation phenomenon is taking place.

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REFERENCE

1 Margolina, A. and Wu, S. *Polymer* 1988, **29**, 2170

* See reference 1

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