Rheological Aspects of Biomedical Materials

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ABSTRACT

Rheology, the study of the deformation and flow of matter under the influence of an applied stress has important applications in biomedical applications. The rheological properties are dependent upon the micro-structure of the material and by changing for example the polymer architecture, the viscosity and elasticity in the material will be changed. The important properties of the solid biomaterial can be described by its elasticity or resilience, when it is deformed it will store the energy and fight back. It can also be described with a spring that regains its original shape after being deformed. This is vital for tissue engineering and biomedical applications, the mechanical behaviour of the natural tissue or bone must be known when we use an implant. For example, bone shows a viscoelastic character and new materials that should work close to the bone as some kind of implant should therefore have similar mechanical behaviour.

We have during many years synthesized materials aimed for the biomedical field, by varying the polymer architecture we alter the mechanical properties and the rheological behaviour.[1-4] Most recently block copolymers with resilient properties were synthesized.[5] The stress strain behaviour of this polymer is shown in figure 1. It is the stress-strain behaviour upon loading and re-cycling a) 1st cycle, b) 2nd cycle, c) 20th cycle, d) 21st cycle (after 16 h relaxation) and e) 25th cycle (after 16 h relaxation)

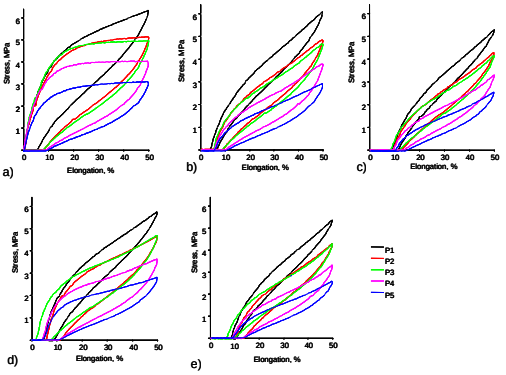

Figure 1. Stress strain behaviour of a block copolymer polymer upon loading and re-cycling a) 1st cycle, b) 2nd cycle, c) 20th cycle, d) 21st cycle (after 16 h relaxation) and e) 25th cycle (after 16 h relaxation)

All copolymers were highly elastic, showing 80% recovery even after 25 cycles.

DMA analysis of the material gives also important information regarding the mechanical properties and rheological behaviour, a typical curve is shown in figure 2. The storage modulus of the copolymers, *E*', and the loss modulus *E*'' was dependent upon the different amount of monomers within the polymer.

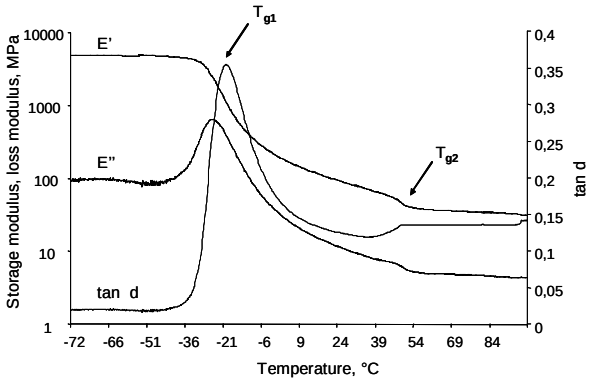

Figure 2. DMA curve of a block copolymer.

These kinds of discussions, structure and properties will be discussed during this lecture. This is knowledge that must be known to find a useful implant in biomedical applications.

REFERENCES

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