

Setup instructions for a homemade film stretching device

J. Bastos-Arrieta, F. Gattwinkel, J. Simmchen*

Email: juliane.simmchen@tu-dresden.de

Introduction

The intrinsic features of micro- and nanoparticles, including size, shape and chemical composition, play a relevant role in different physical and biological recognition processes.^[1] Their functional behavior relies greatly on shape effects. Some physical and chemical approaches like microfluidics and photolithography, have been proposed to obtain different morphologies, but they usually result in time consuming and require expensive instrumentation.^[2]

Physical Stretching is an interesting strategy to induce the morphological deformation of colloidal particles. This method implies the use of melt-able colloids which are embedded in a polymeric support, in which the composite is heated above the glass transition temperature of the particles. The overall effect is the deformation of the particles within the polymeric matrix.

Here, we present a low-cost homemade stretching device, prepared by assembling miscellaneous laboratory components. This device has been used for the preparation of elongated polystyrene particles as well as for increasing the spatial distribution of particles in films.

Components:

- | | | |
|-----------|---|---|
| 4x |  | Laboratory Stand Supports |
| 4x |  | Adjustable Clamps |
| 1x |  | Homemade support with Pulley / Rail
assemble to Stretch / Compress |
| 2x |  | Clip grip clamps fixed to stretching rail |
| 1x |  | Oil bath and heater |

Dimensions:

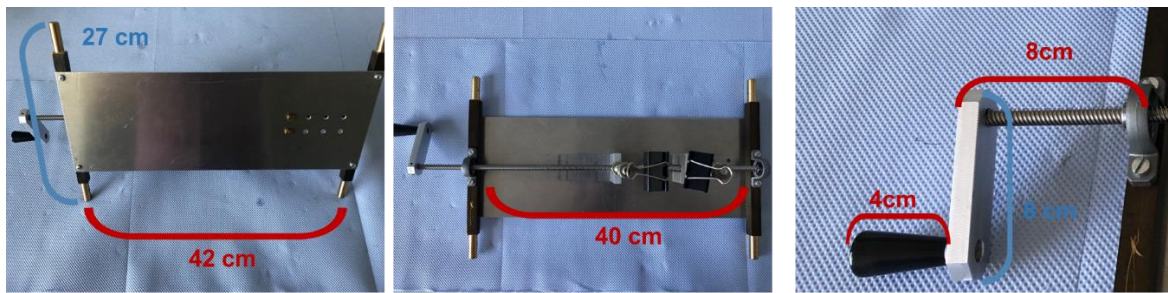


Figure 1: Homemade support with Pulley / Rail assembly to Stretch / Compress

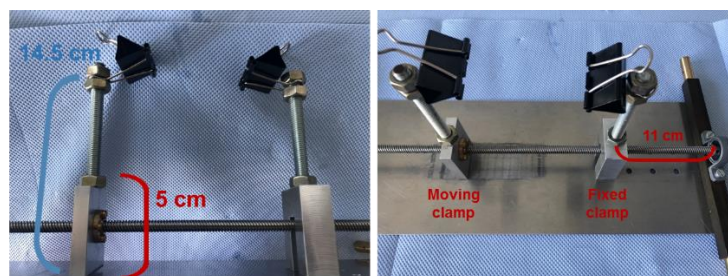


Figure 2: Clip grip clamps fixed to stretching rail

Assembly:



Figure 3: Connect the adjustable clamps to the stretching device (A) and to the standing supports (B)

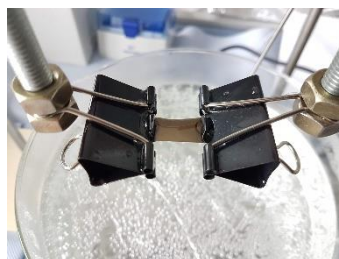


Figure 4: Position of the film in the clip grip clamps as follows:

Stretching for the example of 5 μ m Polystyrene(PS) beads into oval shapes (based on Champions et.al 2007^[2,3])

Materials and Film preparation

PS spherical particles (radii 5 μ m), isopropanol, glycerol and Polyvinylalcohol (PVA) were purchased from Sigma Co. Ltd. Polymeric films were prepared by dissolving 2 to 4 of PVA in in 85°C water. Then, 2% (wt/vol) glycerol was added to plasticize PS particles were added to this mixture at a concentration of 0.04–0.7% (wt/vol), and the films were dried on a flat surface overnight.

Stretching process:

The stretching procedure relies on heating the PS particles (or the desired material) above their glass transition temperature. The polymeric film were the particles are embedded (PVA in this case) is stretch to create void space around the particles. The liquefied particles fill this space and after cooling, the remain in the “stretched-elongated” shape.

In detail, the PS embedded PVA film is placed in the clip grip clamps as shown previously. The oil bath should be heat up until 120°C before proceeding with the immersion of the film by taking down the adjustable clamps. At this point, the film is left immersed from 5 to 10 min, to ensure the liquefying of the PS particles. Then, the film can be stretched smoothly by turning the handle. Stretching can be carried out as far as the film remain properly clamped in. Finally, when the desired stretch length is obtained, the film is kept 5 min in the oil bath before placing it back into the original position, as seen in the example of Figure 5. These stretched particles are obtained by dissolving the film in 30% (v/v) isopropanol/water mixture overnight at 65 °C. The particles are finally washed in 30% (v/v) isopropanol/water mixture and collected by centrifugation at 3000 rpm for 5 min.

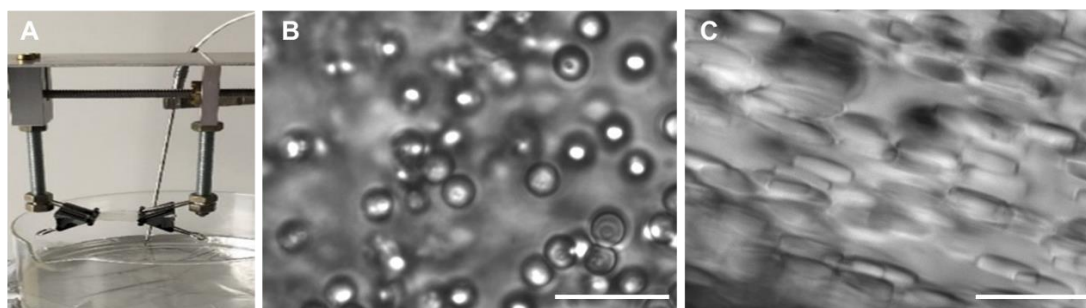


Figure 5: Stretching process of PVA film with embedded PS particle: original film and particles (A, B) and b) resulting PS elongated particles. Scale bar corresponds to 20 μ m.

Acknowledgements

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