Microrheometric study of damage and rupture of capsules in simple shear flow

Chaymae El Mertahi[1], Nicolas Grandmaison[2], Claire Dupont[1], Rachid Jellali[3], Delphine Brancherie[4], and Anne-Virginie Salsac*†[5]

[1]Biomécanique et Bioingénierie – Université de Technologie de Compiègne, Centre National de la Recherche Scientifique – France

[2]Laboratoire de BioMécanique et BioIngénierie – UMR CNRS 7338 Biomechanics and Bioengineering – France

[3]Biomécanique et Bioingénierie – université de technologie de Compiègne, CNRS UMR 7338 centre de recherche de Royallieu 60203 Compiègne – France

[4]Université de Technologie de Compiègne (UTC) – Laboratoire Roberval, UTC, Sorbonne universités, Université de Technologie de Compiègne, Centre de recherche Royallieu, CS60319, 60203 Compiègne Cedex, France – Université de Technologie de Compiègne - Centre de Recherche de Royallieu - rue du Docteur Schweitzer- CS 60319 - 60203 COMPIEGNE Cedex, France

[5]Laboratoire Biomécanique et Bioingéniérie (BMBI) – Université de Technologie de Compiègne, CNRS : UMR7338 – Université Technologique de Compiègne 60205 COMPIEGNE CEDEX, France

Abstract

Microcapsules, which are fluid droplets enveloped by a thin elastic membrane, are widely used in industry to protect and
transport active substances, aromas, cells, etc. When subjected to an external flow, they undergo strong deformations, which can potentially lead to their breakup. Since the 1990's, capsule membrane properties have been studied until breakup subjecting the particles to various flow conditions: simple shear flow (1), hyperbolic flow (2), spinning flow (3), tube flow (4), etc. But hardly any study provided a comprehensive set of experimental data on rupture or investigated the underlying damage phenomena that eventually lead to breakup. To overcome the lack of experimental data in the literature, we have conducted a microrheometric study of microcapsules, subjecting them to simple shear flow conditions leading to their damage and rupture. Our objectives are to characterize the impact of damage on the mechanical properties of the capsule membrane and determine the occurrence of rupture depending on the parameters of the problem. Suspensions of ovalbumin microcapsules are prepared using an interfacial cross-linking technique (5). This technique provides spherical deformable capsules with radii ranging from a few dozens to a few hundreds of microns. To avoid any osmotic prestress in the membrane caused by differences in concentration between the internal and external fluids, capsules are suspended in a glycerol solution containing 3

*Speaker

†Corresponding author: a.salsac@utc.fr