HOW TOPOGRAPHY AFFECTS WETTING AND DEWETTING PROPERTIES OF SURFACES OF COMPOSITE MATERIALS Néstor O. Fuentes (1)(2), Eduardo A. Favret (2). (1) Comisión Nacional de Energía Atómica, CAC – UA Materiales, Av. del Libertador 8250. 1429 – Buenos Aires, Argentina. (2) Instituto de Tecnología "Prof. Jorge A. Sábato" – UNSAM - CNEA, Av. Gral. Paz 1499, B1650KNA – San Martín, Buenos Aires, Argentina. Email: Nestor.Fuentes@cnea.gov.ar

Early description of wetting phenomena was formulated in the 19th century from the basis of Young's equation with the balance of surface tensions acting on a water drop of millimeter or micrometer sizes. A drop fulfilling this equation is set to be partially wetting the substrate and has a contact angle close to 90º. For angles smaller than 90º the drop will flatten out to form a film. On the other limit, if the contact angle increases almost until 180º the surface will remain dry. It was in the first half of the 20th century, with the works of Wenzel [1] and Cassie and Baxter [2] that the effect of surface structure has come into play for the first time. Since then, many scientific investigations have been devoted to explain how surface roughness can induce wetting or non-wetting behavior [3-5]. The importance of understanding these complex mechanisms relies on the possibility to design functional surfaces with direct applications in fields like biotechnology, corrosion-free medical devices, lubrication, and use of adhesives on space qualified composite structures. In the present work, it is reported the study of the effects of topographic changes of a given surface on the wetting or dewetting processes. Different materials made of glass fibers or carbon fibers reinforced composites were used to characterize the fluid behavior in response to surface pattern modifications. Starting from surfaces with smooth topography, several random rough patterns were obtained with a combination of spray adhesives and the deposition of carbon particles. Scanning electron microscopy was used to determine the size of particles and the characteristics of each change in topography. From digitized SEM images, the RIMAPS technique [6-10] and the Variogram method [11, 12] gave a quantitative description of the geometry of topographic patterns and determine the values of the typical scale lengths that were introduced with every modification. Figure 1 illustrates the results obtained in this work. Two examples of surface topography are given in Fig. 1 (a) and (b). Fluid behavior on both surfaces is represented by the different contact angles and shapes of drops shown in Fig. 1 (c) and (d). It can be observed that contact angle increases from 80º to 130º and for the same volume of water (5μl) in one case the drop flattens until reaching 3mm and in the other case its diameter is 1.5mm with spherical shape. Both cases have distinctive scale lengths (Fig. 1 (e) and (f)) that can be expressed as multiples of one of them. In general, the contact angles increases when smaller scale lengths appear on surface and, as a consequence, transition is observed to dewetting condition.

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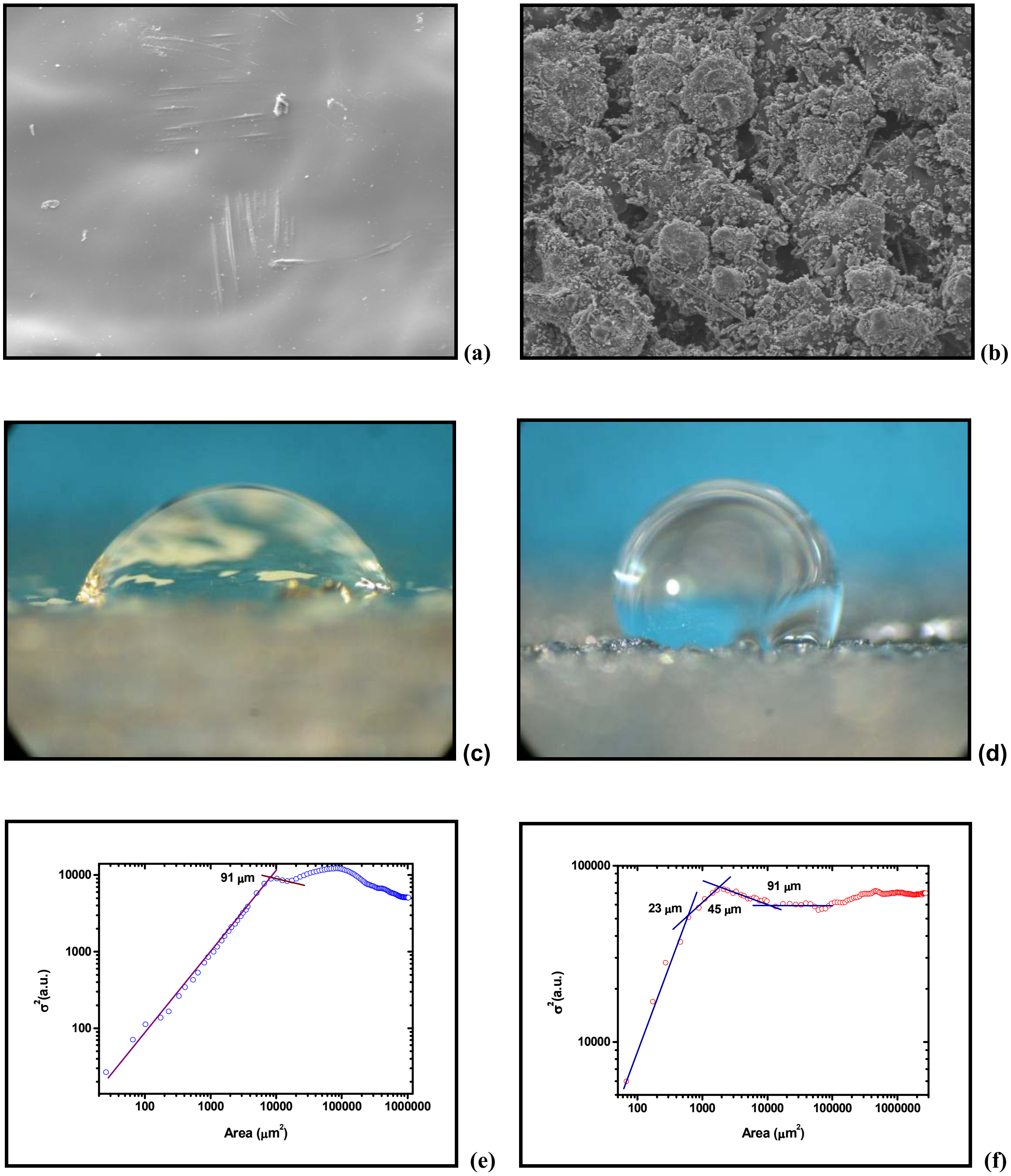

Figure 1. Different wetting conditions on composite materials surfaces. **(a)** SEM micrograph showing the base topography on a surface of glass fiber composite sample. **(b)** SEM micrograph of the new topography obtained after deposition of carbon particles on a glass fiber composite surface. **(c)** Image of a drop of 5 μl on the surface with base topography. **(d)** Image of a drop of 5 μl on the modified topography. **(e)** Variogram analysis showing the first scale length detected on the surface with base topography. **(f)** Variogram analysis showing the appearance of two new scale lengths smaller than in the preceding case.