Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary information for

"Wetting of electrospun nylon 11 fibers and mats"

1. The diameters of the fibers in the gradient nylon-11 samples

The experiments with the gradient nylon 11 samples were repeated three times, which yielded three data series. They consisted of 6, 9, and 8 experimental points, respectively. Figure S1 shows the diameters of the fibers measured in each experimental point. The data display the mean±SD. Most means fall within the range from 175 to 275 nm. Significant deviations from this range are observed at "early" points (points 1 and 2 in series 1, point 1 in series 2, point 1 in series 3), which are characterized by the low surface coverage and a limited number of fibers captured in the SEM images.

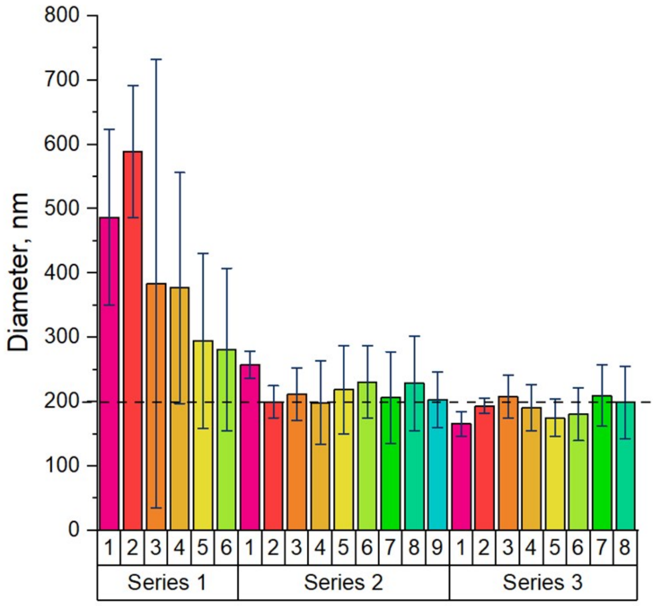

Figure S1 – The diameters of the nylon 11 fibers, three series on the gradient samples. The data shown correspond to mean±SD.

2. Calculation of the surface coverage

The experiments with the gradient nylon 11 samples were repeated three times, which yielded three data series. They consisted of 6, 9, and 8 experimental points, respectively. When we worked with the gradient nylon 11 samples, we related the contact angle with the local surface density of the fibers (surface coverage). When we measured the contact angles, we marked every point (approximately 1 mm in diameter) where a water drop was placed onto the surface. After that, we covered the samples with a metal layer and carried out the SEM examination. We captured 4-8 images with magnification in the range x1500 - x4000 and calculated the coverage A_i for each of these images. The calculation was carried out using Fiji, as shown in Figure S2. After the brightness/contrast correction, we applied a threshold to distinguish between the fibers and the substrate. The particles with the brightness higher than the threshold were changed to absolute white (fibers), and the particles with brightness below the threshold were changed to absolute black (background). With a binary image, the coverage calculation is a straightforward procedure.

Some substrate pixels were relatively bright, so they contributed to the calculated coverage A_i. However, some pixels which belonged to the fibers were not bright enough, and they decreased the A_i. These errors can cancel out each other to some extent; they typically arise when we use threshold filtration to distinguish between the objects and the background. Sometimes, if the bright parts of the substrate clustered in a particular region (Figure S2 B), they were removed manually to reduce the error.

After processing at least four images obtained at a particular region, the mean surface coverage and the corresponding standard deviation were calculated from the set of A_i values.

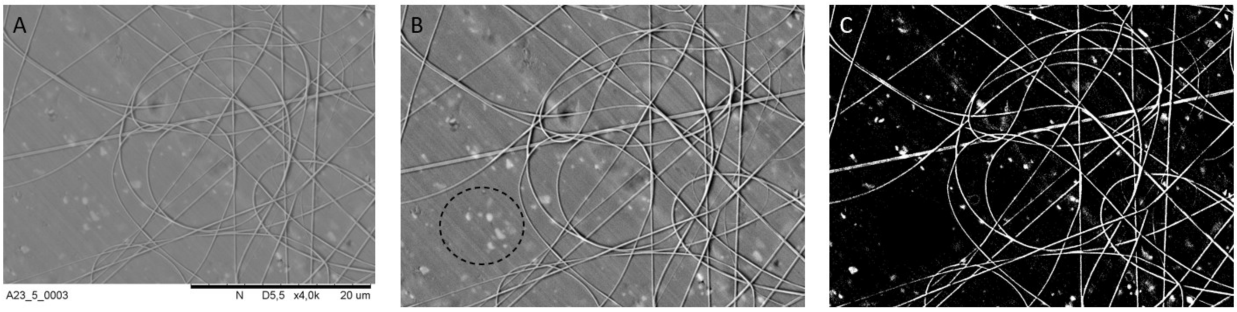

Figure S2 – calculation of the surface coverage. A – raw image, B – the image after cropping, and B/C correction. The black ellipse shows several bright spots on the substrate, which were removed manually. C – a binary mask after.

3. Details about the energy calculation

3.1. The "non-contact" case, Cassie-Baxter model

$E = E_{substrate} + E_{free} + E_{fibers} + E_{voids} + E_{external}$

The drop cross-section radius: $R = R_0 \sqrt{\dfrac{\pi}{\pi - \dfrac{\varphi}{2} + \dfrac{1}{2} sin\varphi}}$

The number of fibers that interact with the drop: $N = 1 + \dfrac{2R}{d} sin\dfrac{\varphi}{2}$ (this value was rounded to an integer)

$E_{external} = (2\pi - \varphi)\sigma_{AW} \cdot R$ – the energy of the top part of the drop

$E_{fibers} = N\,(2r\alpha\sigma_{NW} + (2\pi - 2\alpha) \cdot r\sigma_{NA})$ – the energy of the fibers which are in contact with the drop

$E_{voids} = (N-1) \cdot \sigma_{AW} \cdot (d - 2r sin\alpha)$ – the energy of the bottom part of the drop between the fibers

$E_{free} = 2\pi r(N_0 - N)\sigma_{NA}$ the energy of the free fibers, which are not in contact with the drop

$E_{substrate} = Width \cdot \sigma_{SA}$ – the energy of the substrate surface in contact with air

3.2. The "full spreading" case

The drop cross-section radius: $R = R_0 \sqrt{\dfrac{\pi}{\pi - \dfrac{\varphi}{2} + \dfrac{1}{2} sin\varphi}}$

The number of fibers that interact with the drop: $N = \frac{2R}{d}\sqrt{1 - (\frac{gap + r - Rcos\frac{\varphi}{2}}{R})^2}$ (this value was rounded to an integer)

$E = E_{substrate} + E_{fibers} + E_{external}$

$E_{external} = (2\pi - \varphi)\sigma_{AW} \cdot R$ – the energy of the top part of the drop

$E_{substrate} = 2R \cdot \sin(\varphi/2)\sigma_{SW} + (Width - 2R\sin(\varphi/2))\sigma_{SA}$ – the energy of the foil substrate

$E_{fibers} = N \cdot 2\pi r\sigma_{NW} + (N_0 - N)2\pi r\sigma_{NA}$ – the energy of the fibers

4. Pore sizes

The pores were measured manually by measurements of the distances between the adjacent fibers at random directions. The dotted line in Figure S3 shows the exponential decay approximation.

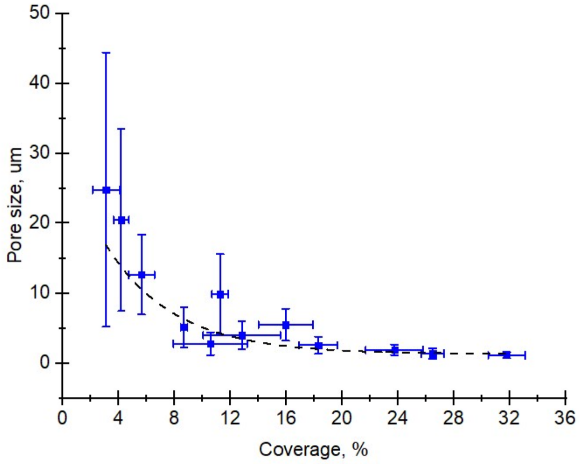

Figure S3 – The relation between the pore size and the surface coverage calculated using the SEM images of the gradient samples.