Supplementary Figures

Ultrafast propagation of β-amyloid fibrils in oligomeric cloud

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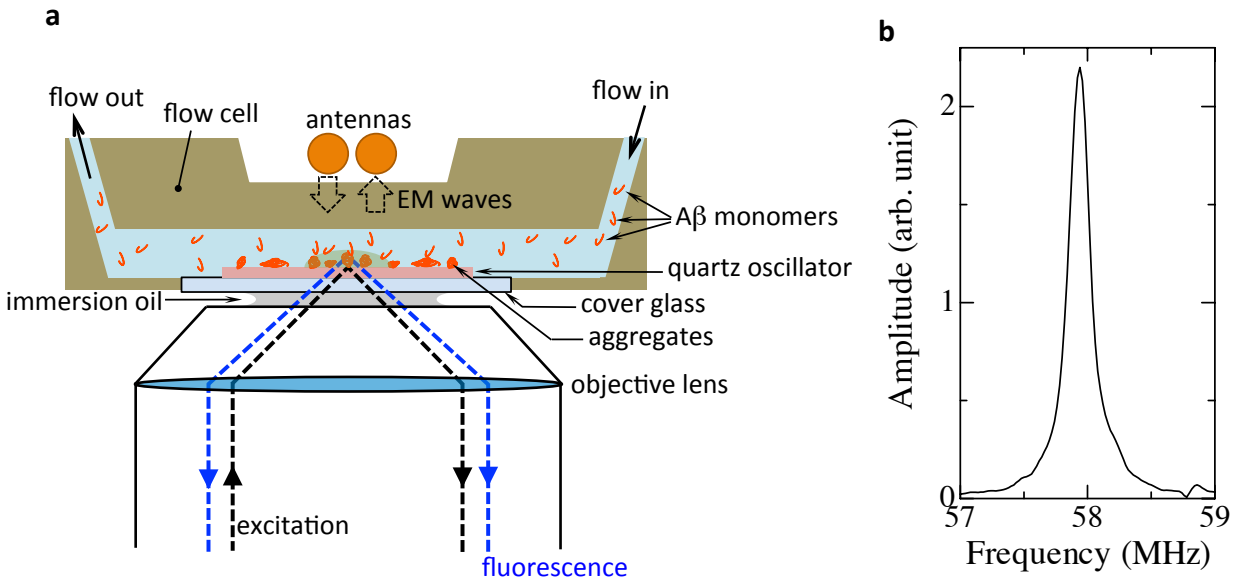
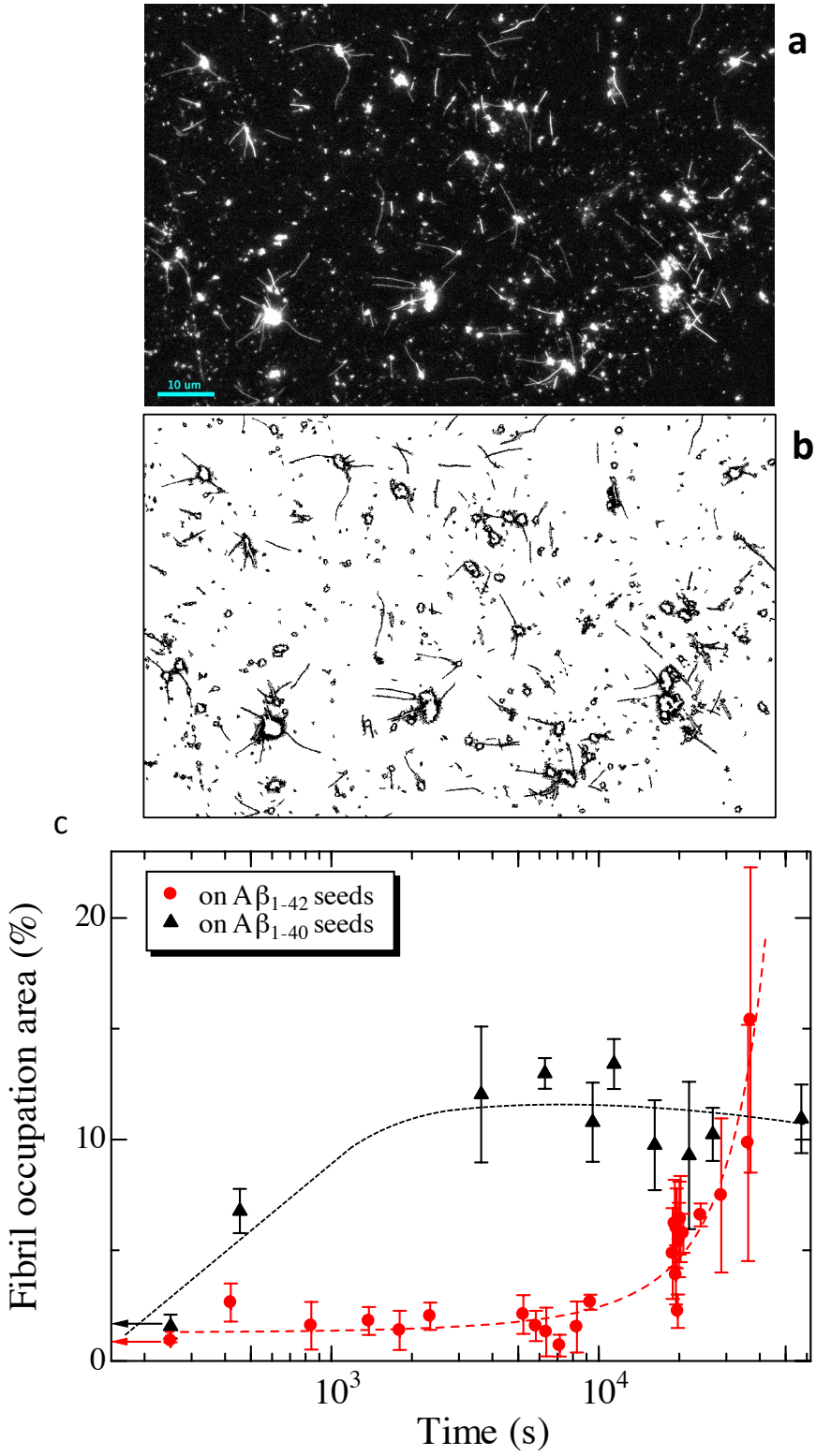
Supplementary Figure 1 The TIRFM-QCM system



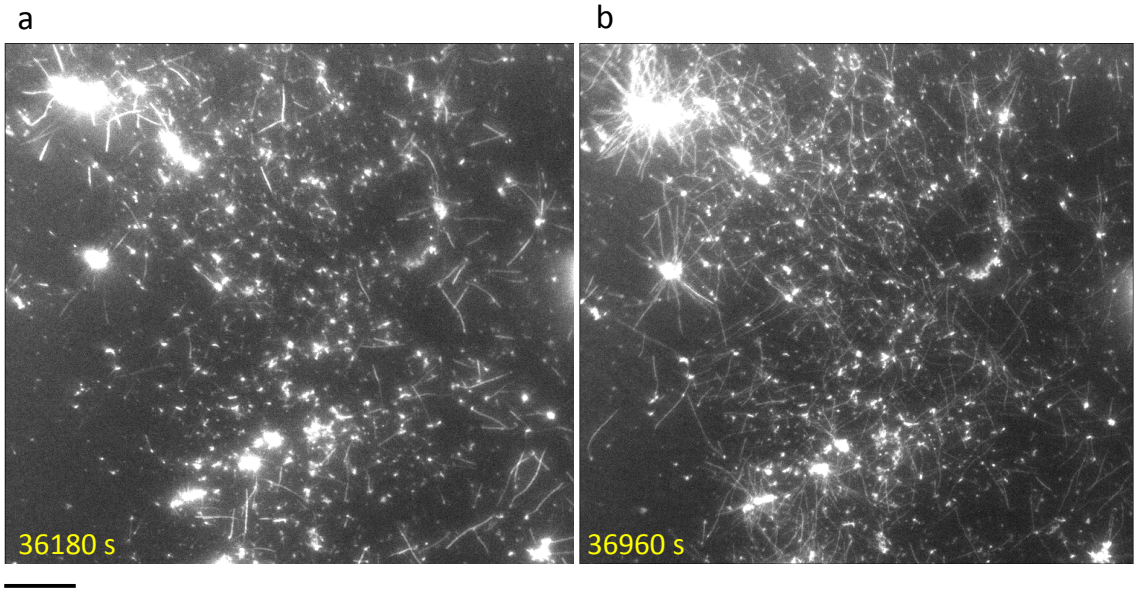
(a) Schematic of cross-section view of originally developed total-internal-reflection-fluorescence-microscopy quartz-crystal-microbalance (TIRFM-QCM) system. An AT-cut quartz resonator (2.5x1.7x0.0285 mm^3) is attached on a cover glass (0.15 mm thick), on which Aβ seeds were immobilized and the $Aβ_{1-40}$ monomer solutions were flowed. Two line antennas for generation and detection of the shear vibration of the resonator were located outside the microchannel. (b) A measured resonant spectrum during the solution flow.

Supplementary Figure 2 Analysis of amount of deposited fibrils on surface.



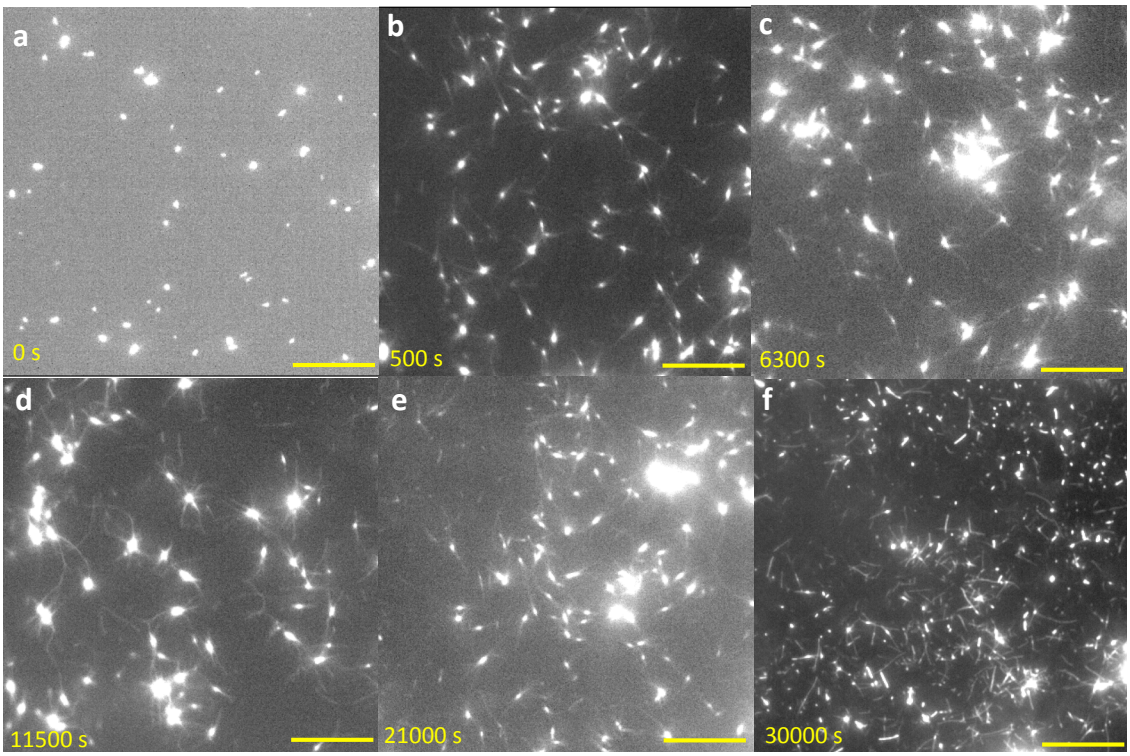
(a) A TIRFM image at 18900 s on the flow measurement of 10-μM $A\beta_{1-40}$ solution on the $A\beta_{1-42}$ seeds and (b) its binarization using the software Image J. Smaller particles than 100 nm^2 were removed in the analysis. (c) Evolution of amount of fibrils on the surface obtained by the analysis of TIRFM images during the deposition reaction of 10-μM $A\beta_{1-40}$ monomers on $A\beta_{1-42}$ and $A\beta_{1-40}$ seeds. Few fibrils appeared for the reaction on the $A\beta_{1-42}$ seeds, whereas fibril elongation was observed from the early stage on the $A\beta_{1-40}$ seeds (see Supplementary Fig. 4).

Supplementary Figure 3 Fast formation of fibril network bridging nuclei.



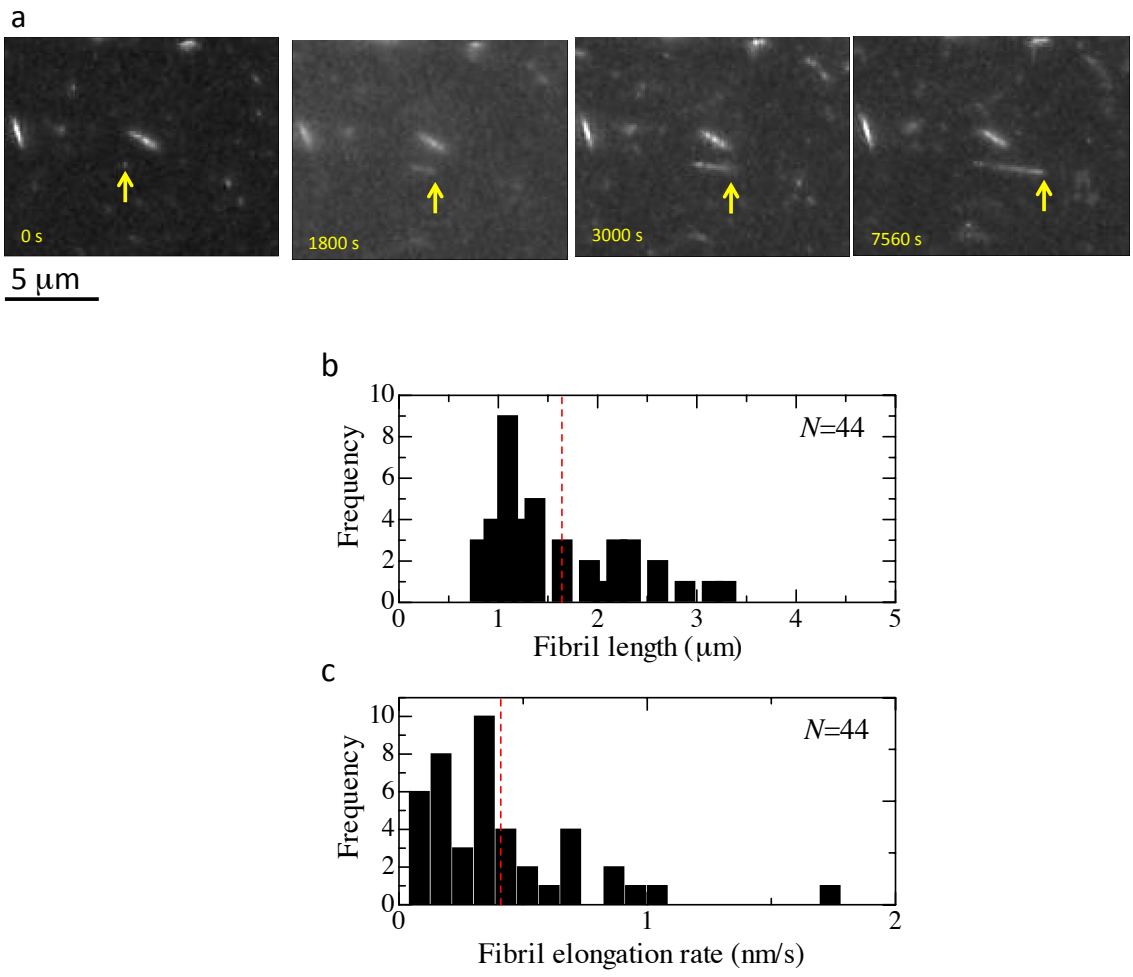
TIRFM images at (a) 36180 s and (b) 36960 s observed for the solution-flow measurement (10-μM $A\beta_{1\text{-}40}$). Highly developed fibril network is established only for 13 min on nuclei, which are source and sinks of fibrils. The scale bar indicates 10 μm.

Supplementary Figure 4 Evolution of fibrils on $A\beta_{1\text{-}40}$ seeds.



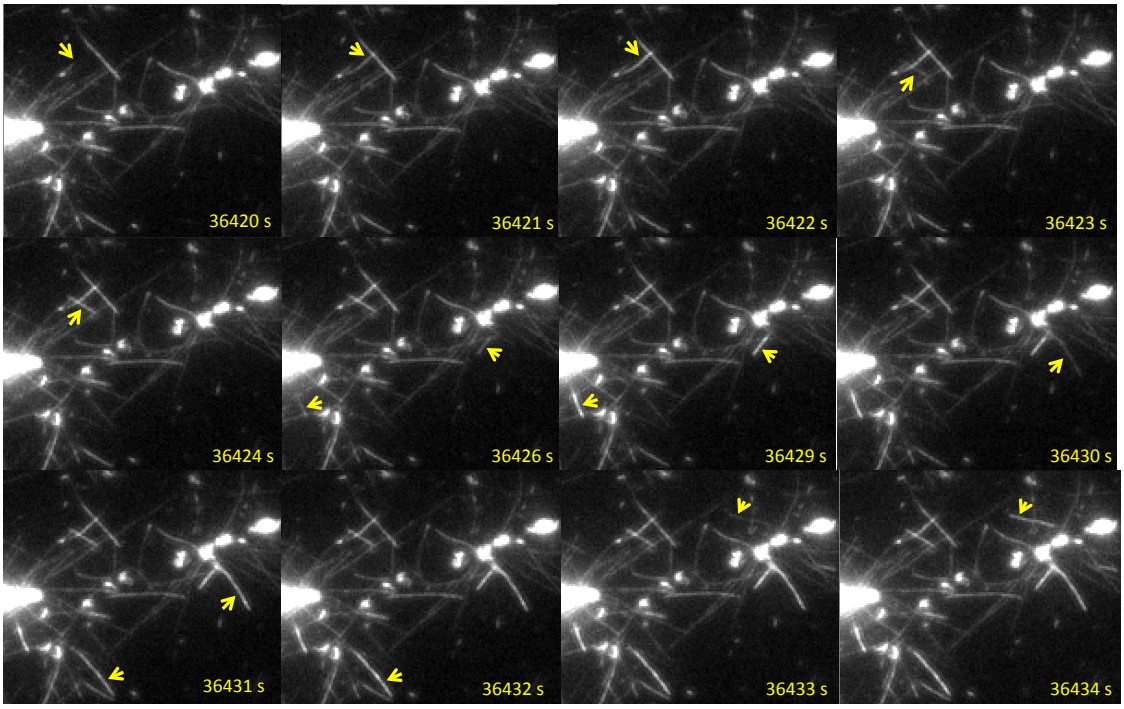
TIRFM images at (a) 0 s, (b) 500 s, (c) 6300 s, (d) 11500 s, (e) 21000 s, and (f) 30000 s for a solution-flow measurement with 10-μM $A\beta_{1\text{-}40}$ on $A\beta_{1\text{-}40}$ seeds grown at pH4.8, corresponding to the data in Supplementary Fig. 2c. Fibrils appear soon after the deposition measurement, and the number of fibrils increases monotonically.

Supplementary Figure 5 Behavior of $A\beta_{1\text{-}40}$ fibril elongation on $A\beta_{1\text{-}40}$ seeds at pH2.4 in a stagnant solution.



(a) Snapshots of the TIRFM images. (b) Histogram for fibril length and (c) that for the fibril elongation rate.

Supplementary Figure 6 Newly created amyloid β fibrils.



Many fibrils in the TIRFM images were recognized first with dark lines and then with bright lines, indicating observations of newly created fibrils. This dark-and-bright behavior is attributed to diffusion of thioflavin T to newly created fibrils.