Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Local Interactions Influence the Fibrillation Kinetics, Structure and Dynamics of Aβ(1-40) but Leave the General Fibril Structure Unchanged

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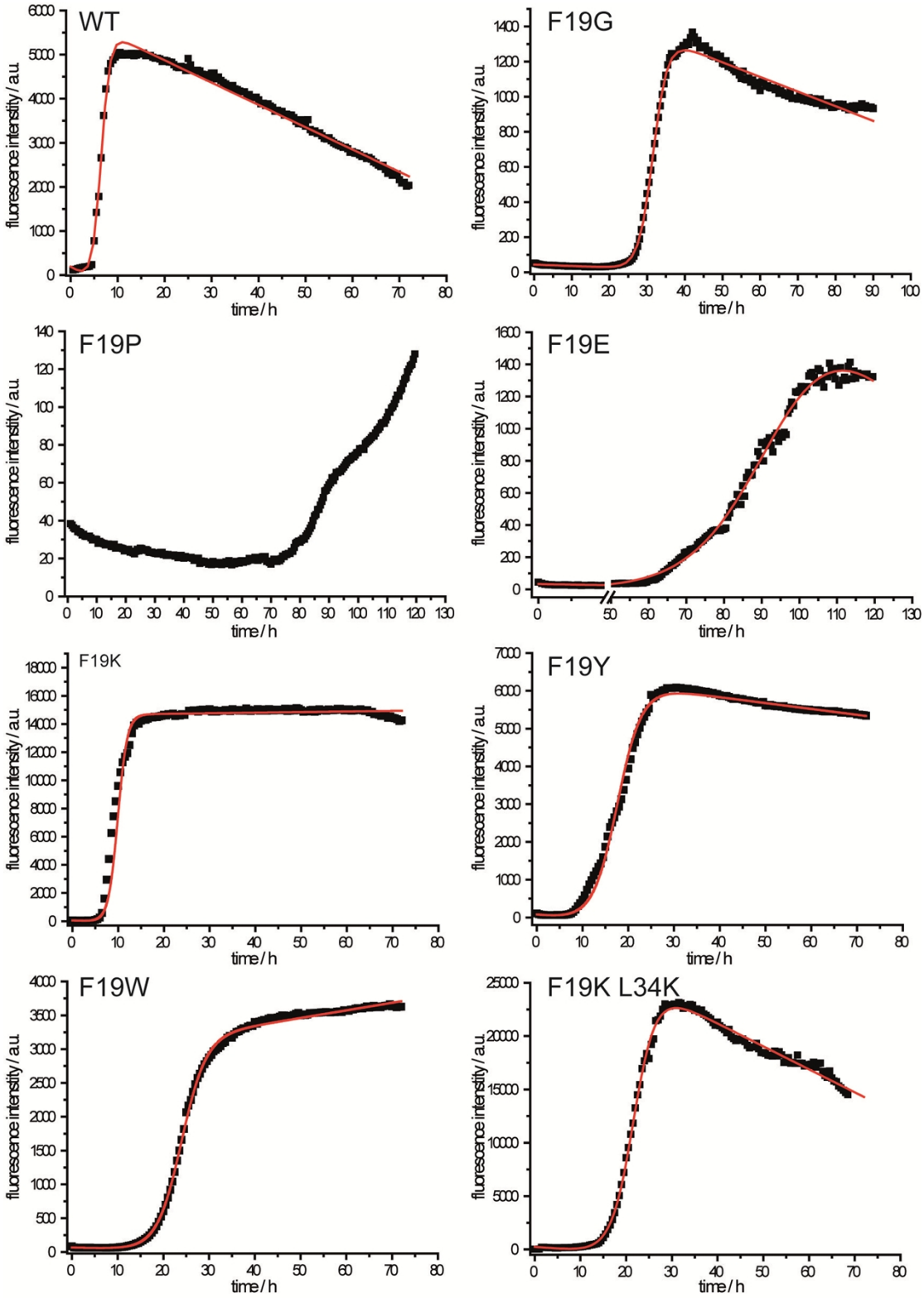

Figure S1. Fluorescence intensity of the WT and mutated Aβ(1-40) samples as a function of time determined by ThT fluorescence in a 96 well plate format using a Tecan Infinite M200 microplate reader. Sample concentration was 1 mg/ ml in phosphate buffer at pH 9.2 in the presence of 20 μM ThT and 150 mM NaCl in a total volume of 150μl. The red lines represent fits of the intensity as a function of time applying the model from Nielsen et al., 2001.

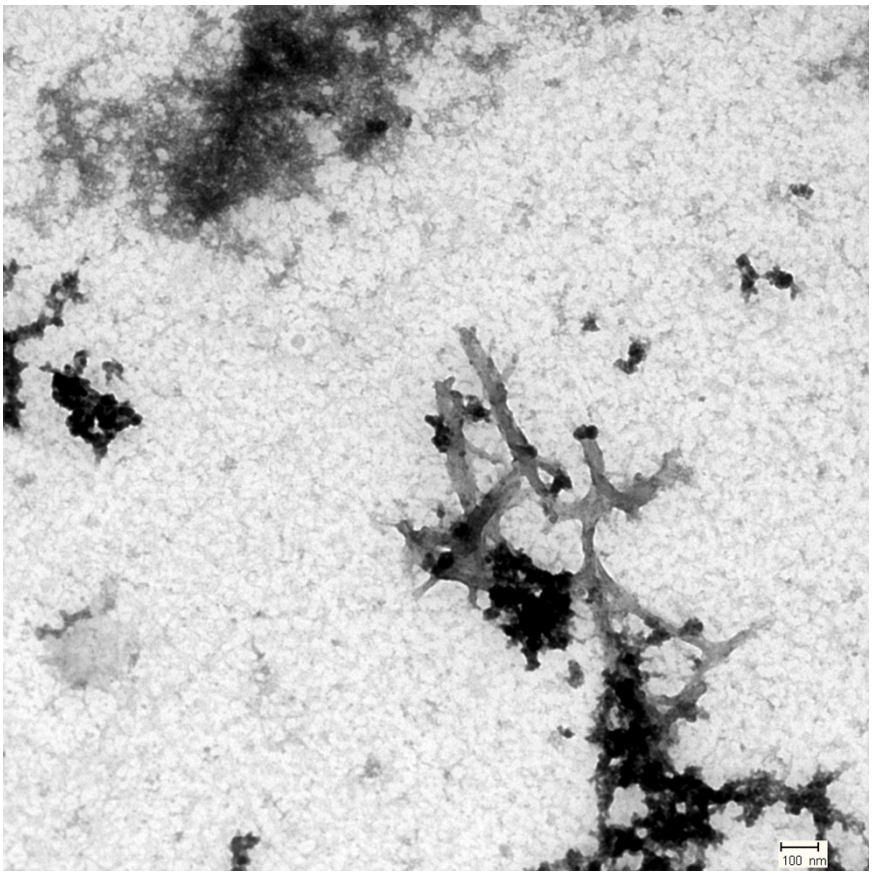

Figure S2. Transmission electron micrographs of the precipitate of the F19K L34E peptide mutants after six months of fibrillation time. Some isolated amorphous aggregates are seen, but no fibrillar morphologies. The precipitate was collected and subjected to solid-state NMR measurements, but only NMR spectra of very poor quality could be acquired from the traces of sample collected. Scalebar: 100 nm

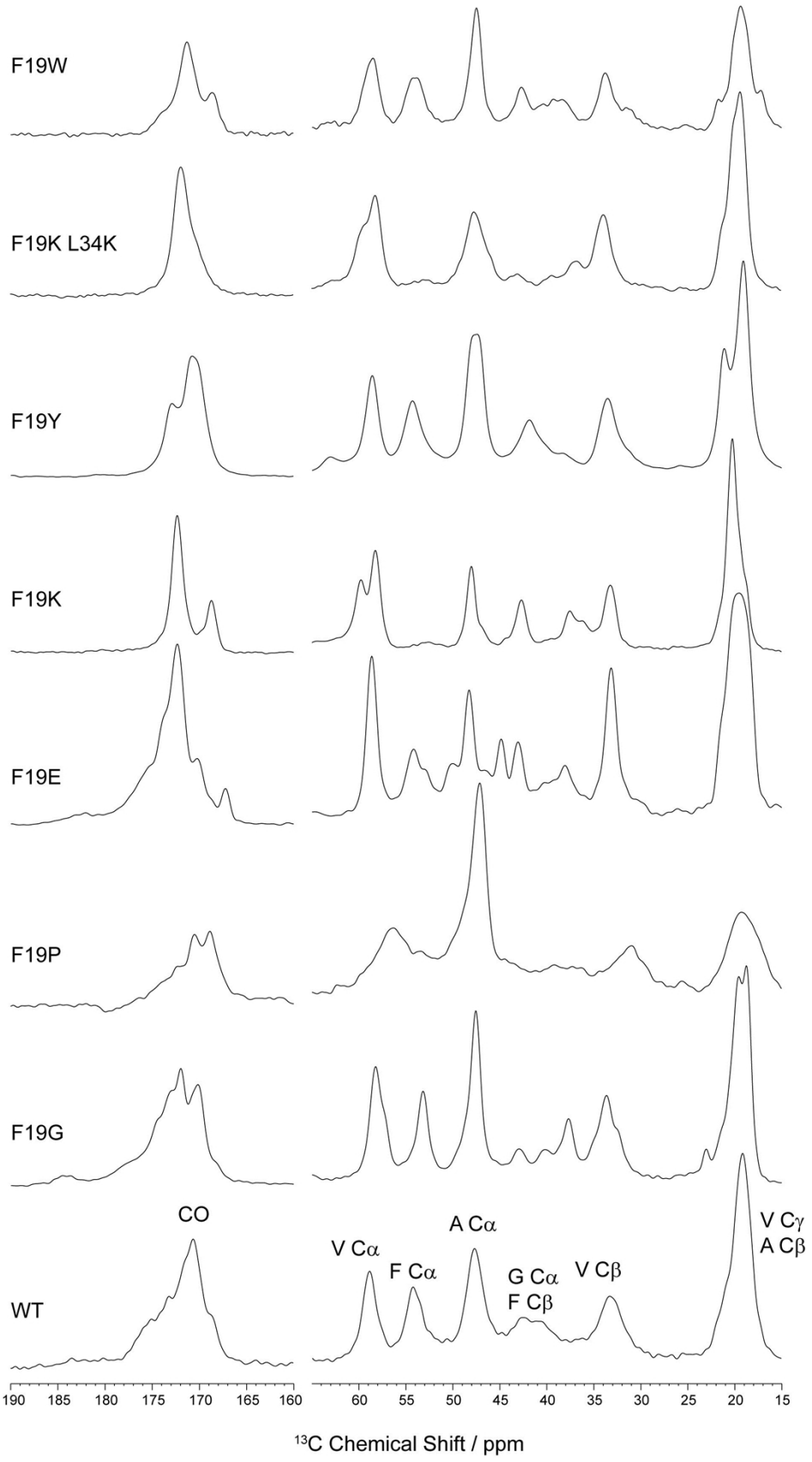

Figure S3 ^{13}C CPMAS NMR spectra of the WT and mutated Aβ(1-40) fibrils investigated in this study. Signal assignment for the labeled sites (V18, F20, A21, G33) is given for the WT.

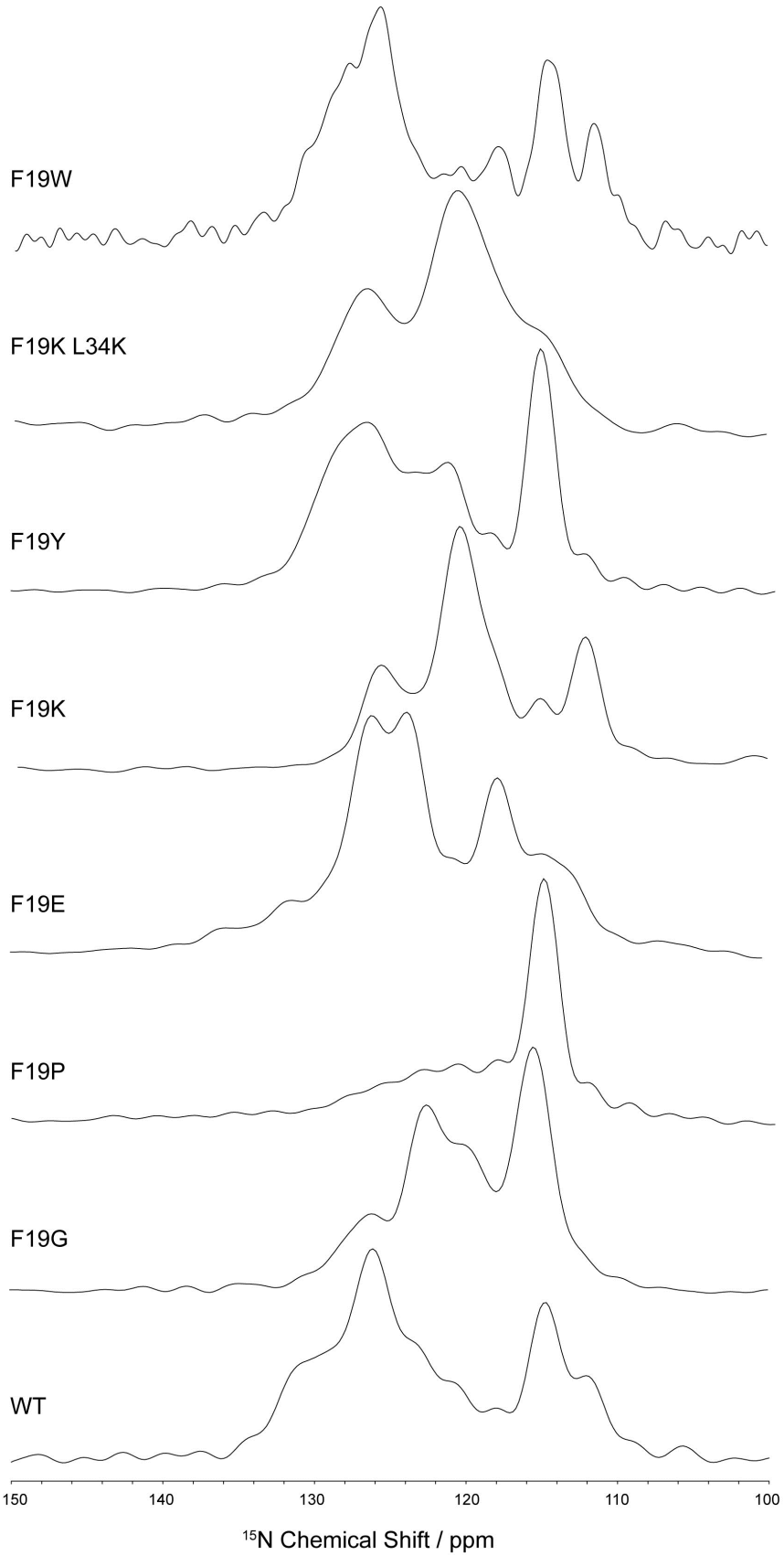

Figure S4. ^{15}N CPMAS NMR spectra of the WT and mutated Aβ(1-40) fibrils investigated in this study.

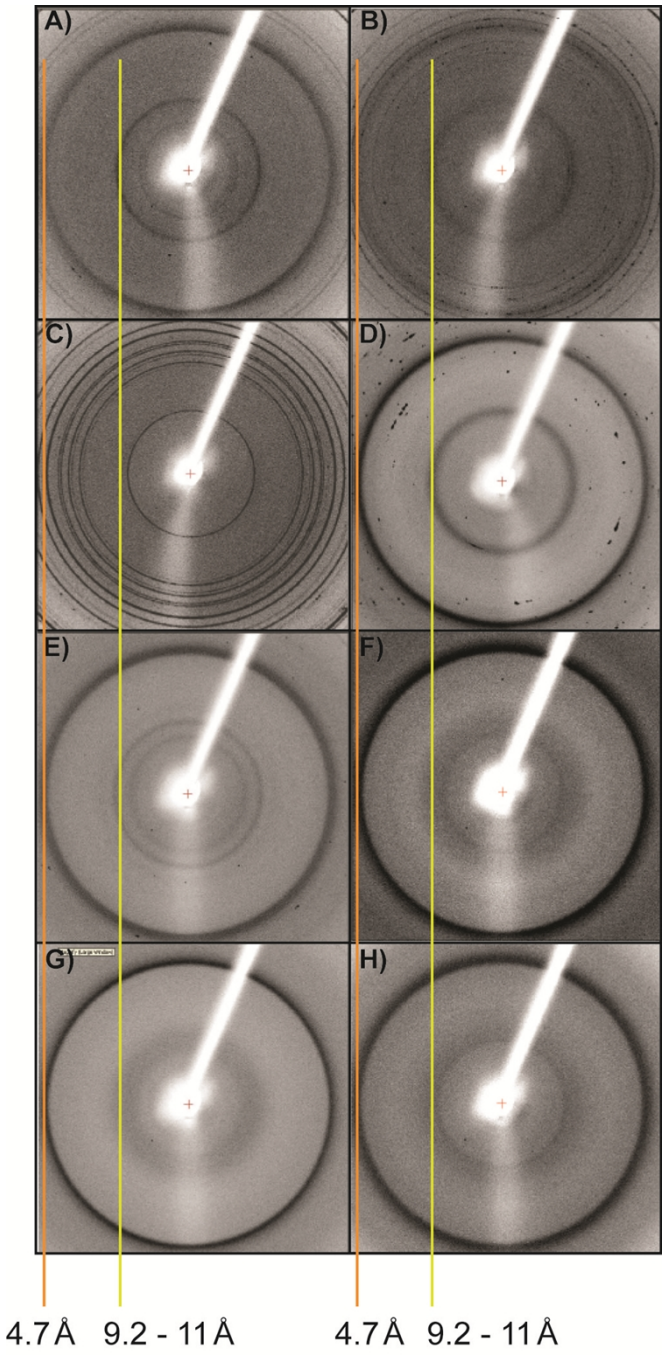

Figure S5. X-ray diffraction patterns for the Aβ(1-40) derived fibrils for the WT (A) and the F19G mutant (B); F19P mutant (C); F19E mutant (D); F19K mutant (E); F19Y mutant (F); F19W mutant (G); as well as the F19K L34K double mutant (H). All diffraction patterns show the meridional peak at ~4.7 Å and the equatorial diffraction at about 9.2 -11 Å. The F19P variant showed more diffraction peaks in the region of ~4.7 Å.

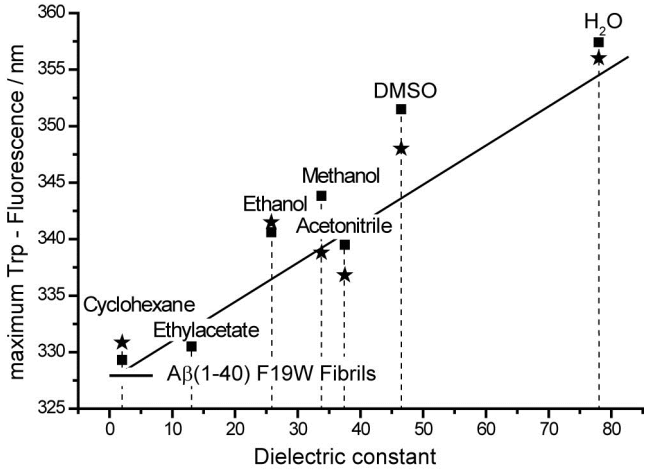

Figure S6. Maximum fluorescence emission wave lengths of pure Trp (★) and the F19W Aβ(1-40) mutant (■) dissolved in various organic solvents indicated by their dielectric constant. The line represents the linear regression of the data. The maximum fluorescence emission wave length of 327.8 nm for the F19W Aβ(1-40) fibrils in aqueous buffer is indicative of a dielectric constant of approximately 5.

Table S1. Analysis of the diameter (n = 20) of the fibrils formed by the WT Aβ(1-40) peptides and the seven investigated mutations determined using ImageJ 1.47t (Wayne Rasband, NIH, USA).

Aβ (1-40)	Diameter / nm
WT	10.0 ± 1.6
F19G	8.2 ± 1.3
F19P	9.5 ± 2.5
F19E	10.0 ± 1.7
F19K	12.6 ± 2.0
F19Y	10.5 ± 1.6
F19W	11.2 ± 1.9
F19K L34K	9.0 ± 2.0

Table S2. Isotropic ^{15}N and ^{13}C chemical shifts (relative to TMS) and order parameters (*S*) for WT Aβ(1-40) fibrils and the seven investigated mutations determined by ^{15}N and ^{13}C CP MAS NMR spectroscopy at 30°C.

Aβ (1-40)	Amino Acid	N / ppm	Cα / ppm	Cβ / ppm	C=O / ppm	Cγ / ppm	Cε / ppm	*S* (Cα)
WT	Val 18	121.4	58.9	33.3	170.7	19.2		0.94 ± 0.09
	Phe 20	123.5	54.2	40.6	171.3		129.3	0.90 ± 0.09
	Ala 21	126.1	47.7	20.7	173.2			1.00 ± 0.10
	Gly 33	114.8	42.6		168.6			0.90 ± 0.09
F19G	Val 18	126.1	58.2	33.6	172.9	19.2		0.97 ± 0.10
	Phe 20	119.8	53.1	37.7	172.1		128.7	0.94 ± 0.09
	Ala 21	122.5	47.5	21.5	169.8			1.00 ± 0.10
	Gly 33	115.4	42.9		168.9			0.99 ± 0.10
F19P	Val 18	126.6	57	31.8	171.0	19.2		0.81 ± 0.80
	Phe 20	121.6	56	38.8	170.5		129.4	0.83 ± 0.80
	Ala 21	119.3	49.1	17.5	172.5			1.00 ± 0.10
	Gly 33	115.1	43.4[1]		168.9			0.90 ± 0.09
			47.1					
F19E	Val 18	126.6	58.6	33.2	172.4	19.6		0.92 ± 0.09
	Phe 20	126.6	54.2	38.1	173.0		129.5	0.85 ± 0.08
	Ala 21	125.9	48.3	21.2	173.1			0.97 ± 0.09
	Gly 33	117.6	44.9[1]		166.9[1]			0.97 ± 0.09
			43.1		169.9			
F19K	Val 18	125.7	58.2	33.3	172.3	20.3		0.96 ± 0.09
	Phe 20	118.4	59.7	37.5	172.3		128.8	0.75 ± 0.07
	Ala 21	120.5	47.8	20.5	172.3			0.95 ± 0.09
	Gly 33	112.1	42.6		168.7			0.98 ± 0.10
F19Y	Val 18	121.4	58.5	33.4	170.5	19.1		0.92 ± 0.09
	Phe 20	126.9	54.4	42	172.9		129.3	0.88 ± 0.09
	Ala 21	128.4	47.8	21.2[1]	170.0			1.00 ± 0.10
				14.1				
	Gly 33	115.3	47.8		169.5			0.99 ± 0.10
F19W	Val 18	124.8	58.5	33.8	171.3	19.4		0.96 ± 0.10
	Phe 20	117.9[1]	53.9	39.3	170.9		129.4	0.92 ± 0.09
		127.6						
	Ala 21	125.9[1]	47.5	21.7	171.5			1.00 ± 0.10
		114.1						
	Gly 33	111.5	42.7		168.6			0.96 ± 1.00
F19K L34K	Val 18	126.7	58.2	33.9	171.7	19.1		0.91 ± 0.09
	Phe 20	120.5	59.5	37.1	171.7		129.1	0.94 ± 0.09
	Ala 21	120.5	47.7	20.0	172.0			0.99 ± 0.10
	Gly 33	115.0	43.1		170.2			0.96 ± 0.09

[1] two signals observed, strongest signal listed first

Table S3. Comparison of the ^{15}N and ^{13}C chemical shifts (relative to TMS) for WT Aβ(1-40) fibrils prepared in this study with agitated fibrils reported in the literature.

Aβ (1-40)	N / ppm	Cα / ppm	Cβ / ppm	C=O / ppm	Cα - Cβ / ppm	Reference
	121.4	58.9	33.3	170.7	25.6	this work
Val 18	123.8	60.2	33.7	171.8	26.5	Bertini et al., 2011
	121.7	58.9	33.6	170.3	25.3	Petkova et al., 2002
	123.5	54.2	40.6	171.3	13.6	this work
Phe 20	129.0	52.5	41.6	172.7	10.9	Bertini et al., 2011
	n.d.[1]	54.6	41.0	170.2	13.6	Petkova et al., 2002
	126.1	47.7	20.7	173.2	27.0	this work
Ala 21	125.6	49.2	19.9	172.7	29.3	Bertini et al., 2011
	130.9	48.2	21.0	172.7	27.2	Petkova et al., 2002
	114.8	42.6	-	168.6	-	this work
Gly 33	115.5	44.3	-	168.3	-	Bertini et al., 2011
	n.d.[1]-	n.d.[1]-	-	n.d.[1]	-	Petkova et al., 2002

[1] not determined

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