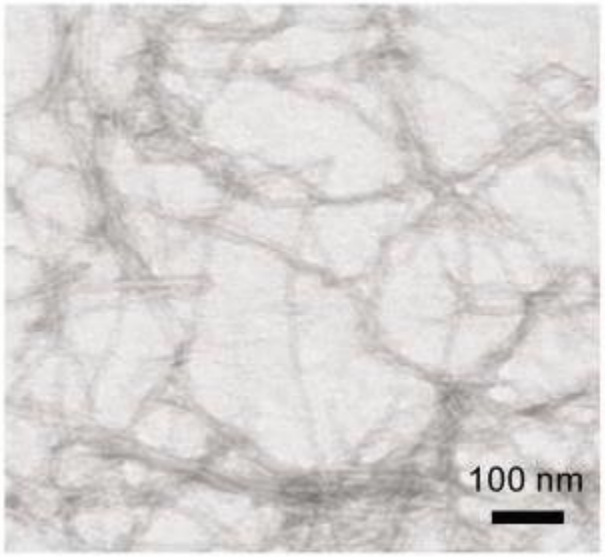
Effect of Carbon Dots on the Fibrillation of Amyloid protein

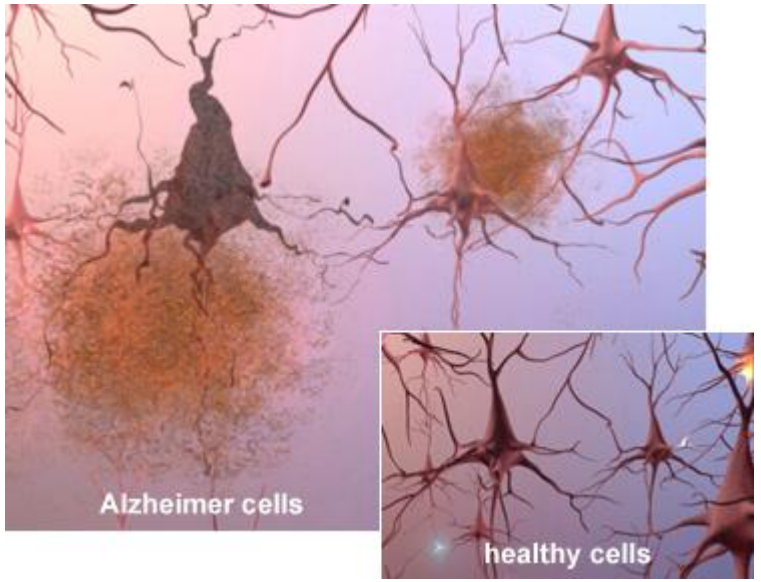
Zhifeng Jing

2016.12.16

Background

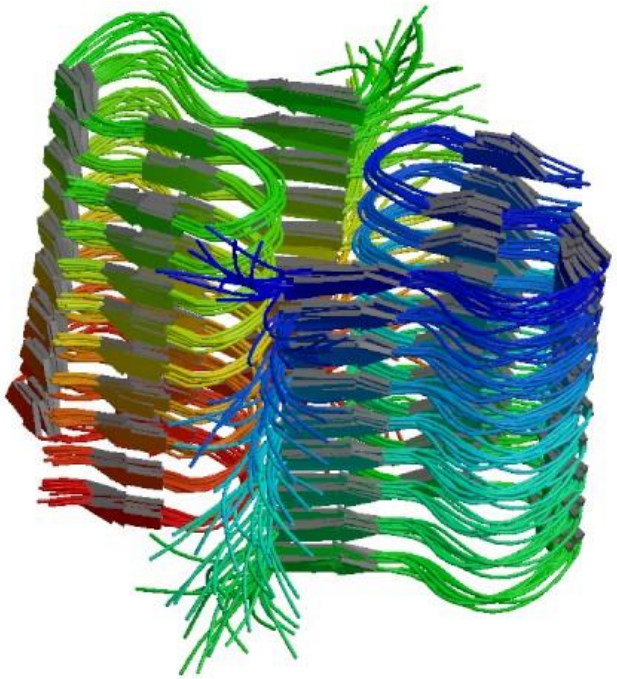
- Amyloid is associated with many diseases including Alzheimer's and Parkinson's



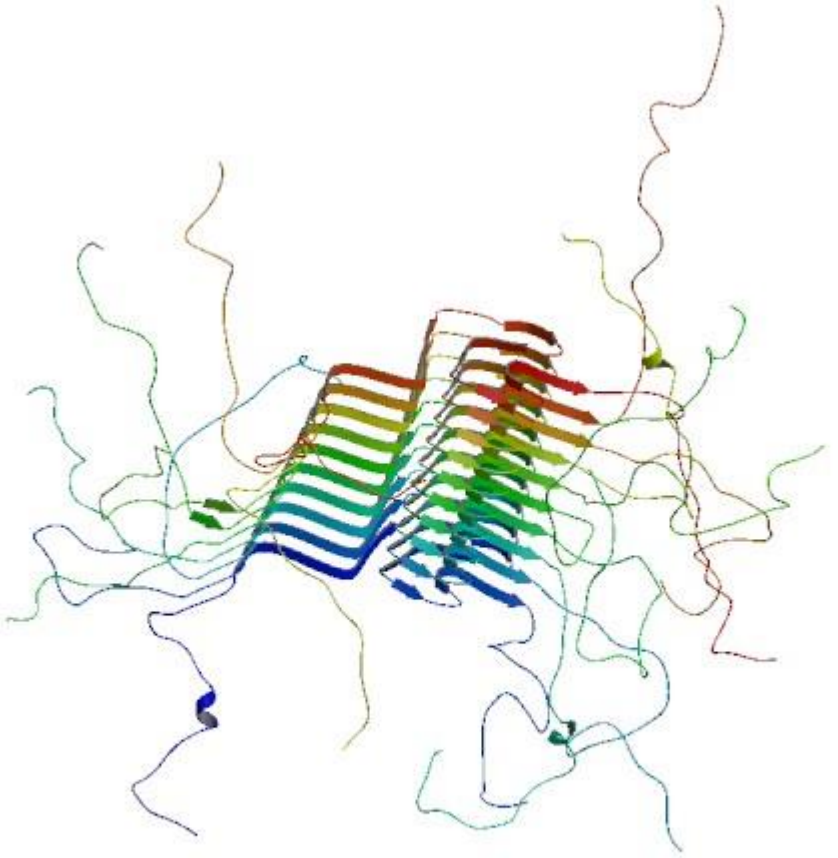


Prion. 2008 Jul-Sep; 2(3): 112–117.
alz.org / braintour

Fibrillation is sequence-independent

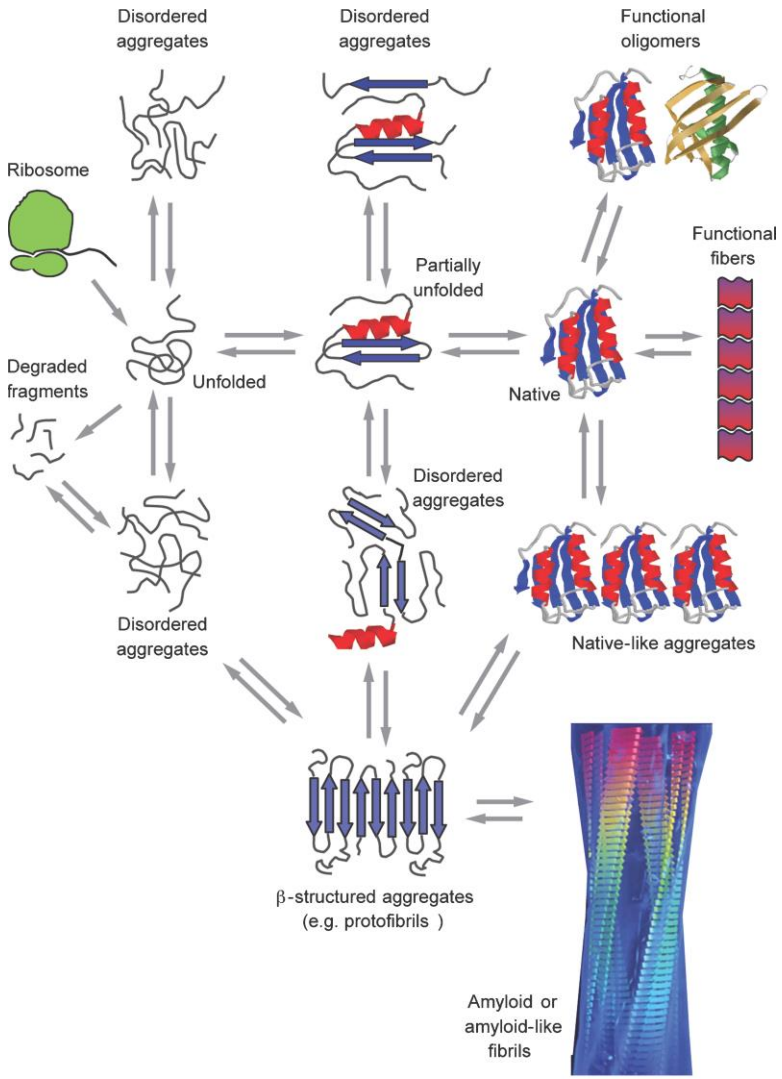


5KK3



2N0A

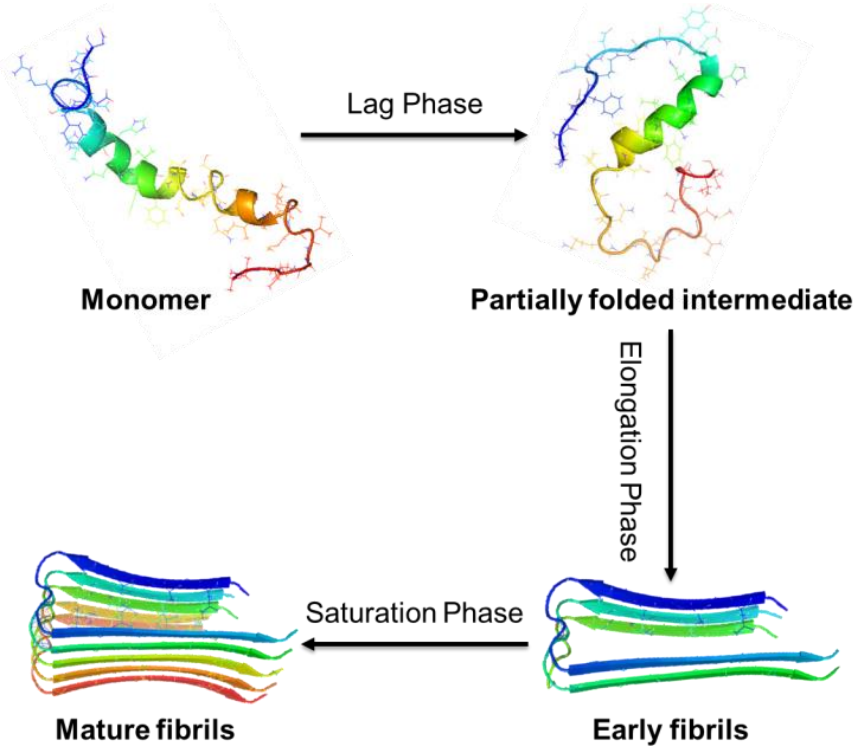
Fibrillation process



Chiti F, Dobson CM. 2006.
Annu. Rev. Biochem. 75:333–66

Fibrillation process

- Two-step mechanism



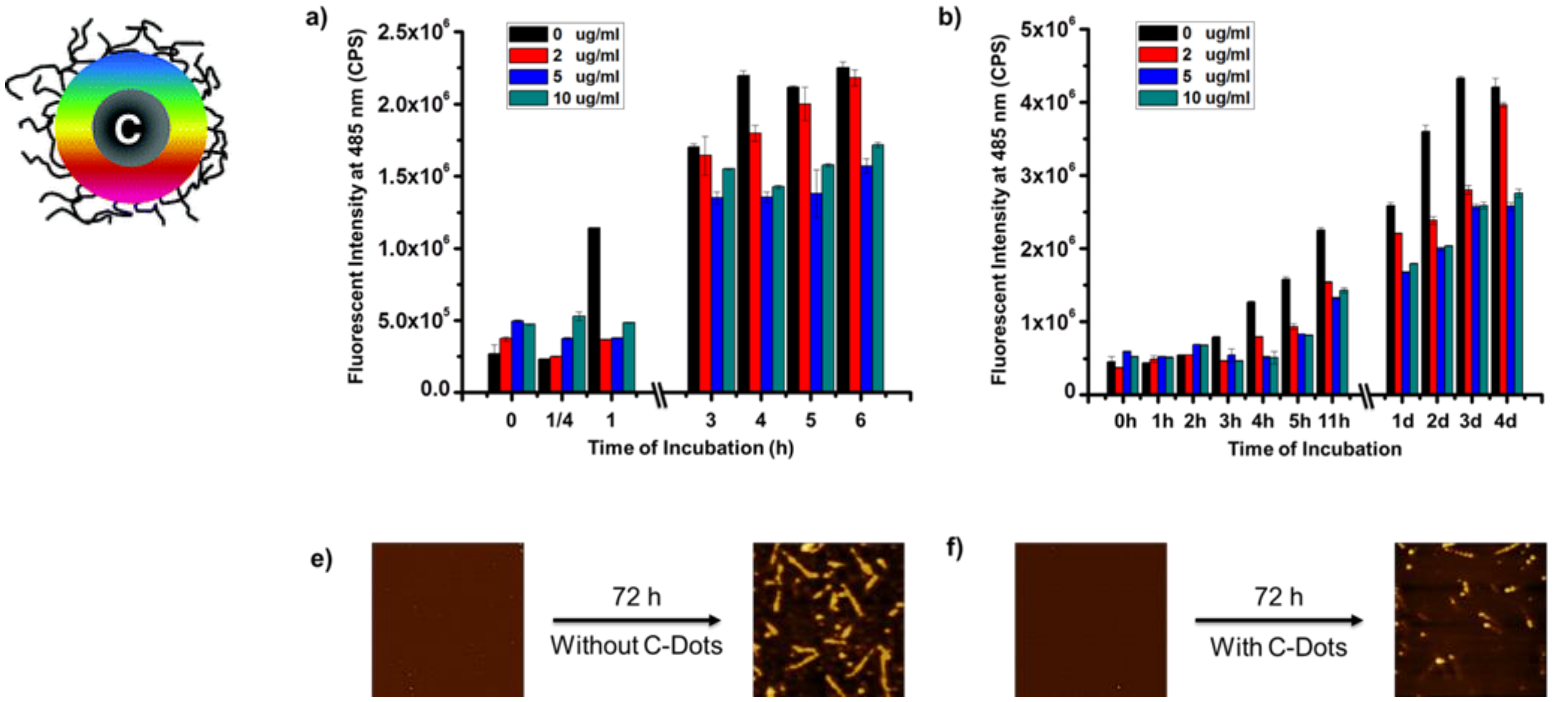
Effects of nanoparticle

- Nanoparticles can either promote or inhibit fibrillation depending on their size and surface properties

Year	Author	Nanoparticle	Diameter	Surface	Effect
2007	Linse	CNT	6 nm	--	Promote
		CdSe	16 nm	Hydrophilic polymer	Promote
2016	Wang	Graphene QD	5 nm	--	Promote
		Carbon Nanodot	4 nm	Amino and hydroxyl	Inhibit
2016	Wang	Graphite Oxide	1.5 nm	--	Inhibit
		CNT	3 nm	Oxygen groups	Inhibit
2003	Kim	Fullerene	1 nm	--	Inhibit

Experimental observation

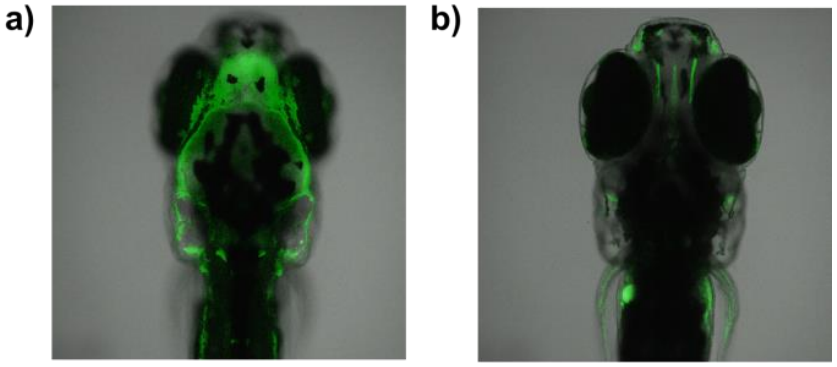
C-Dots inhibits fibrillation in an concentration-dependent manner



X. Han. Unpublished data
Y.-P. Sun, 2006

Experimental observation

Surface engineered C-Dots can cross blood-brain barrier

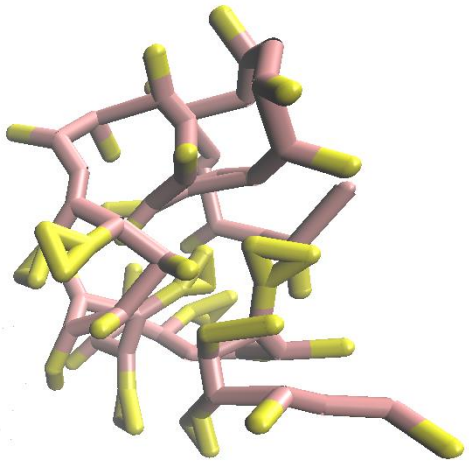


Confocal fluorescent images after 5 h injection of C-Dots

X. Han. Unpublished data

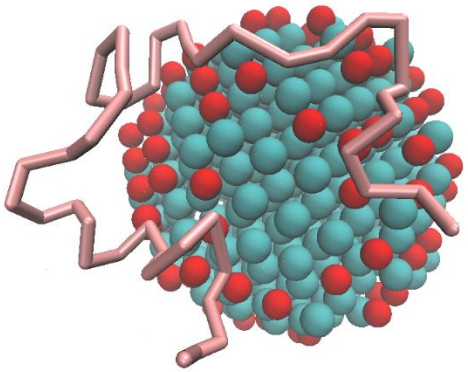
Models

- C-Dots with hydrophilic or hydrophobic surfaces
- Aβ42
- Martini coarse-grained force field

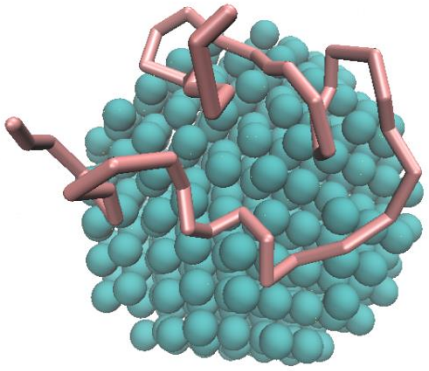


Binding structures

- Extended structures are formed on hydrophilic C-Dots
- Hydrophobic C-Dots promote compact planar structures

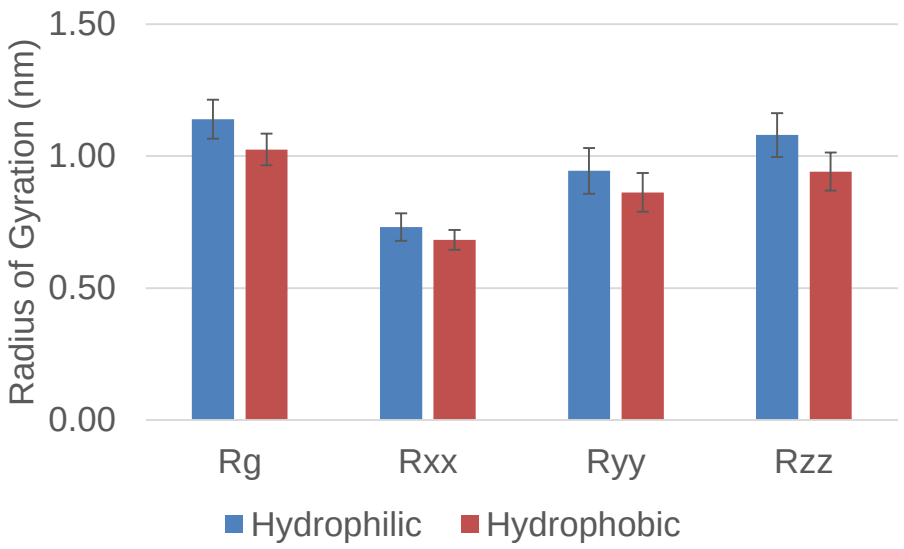


Hydrophilic



Hydrophobic

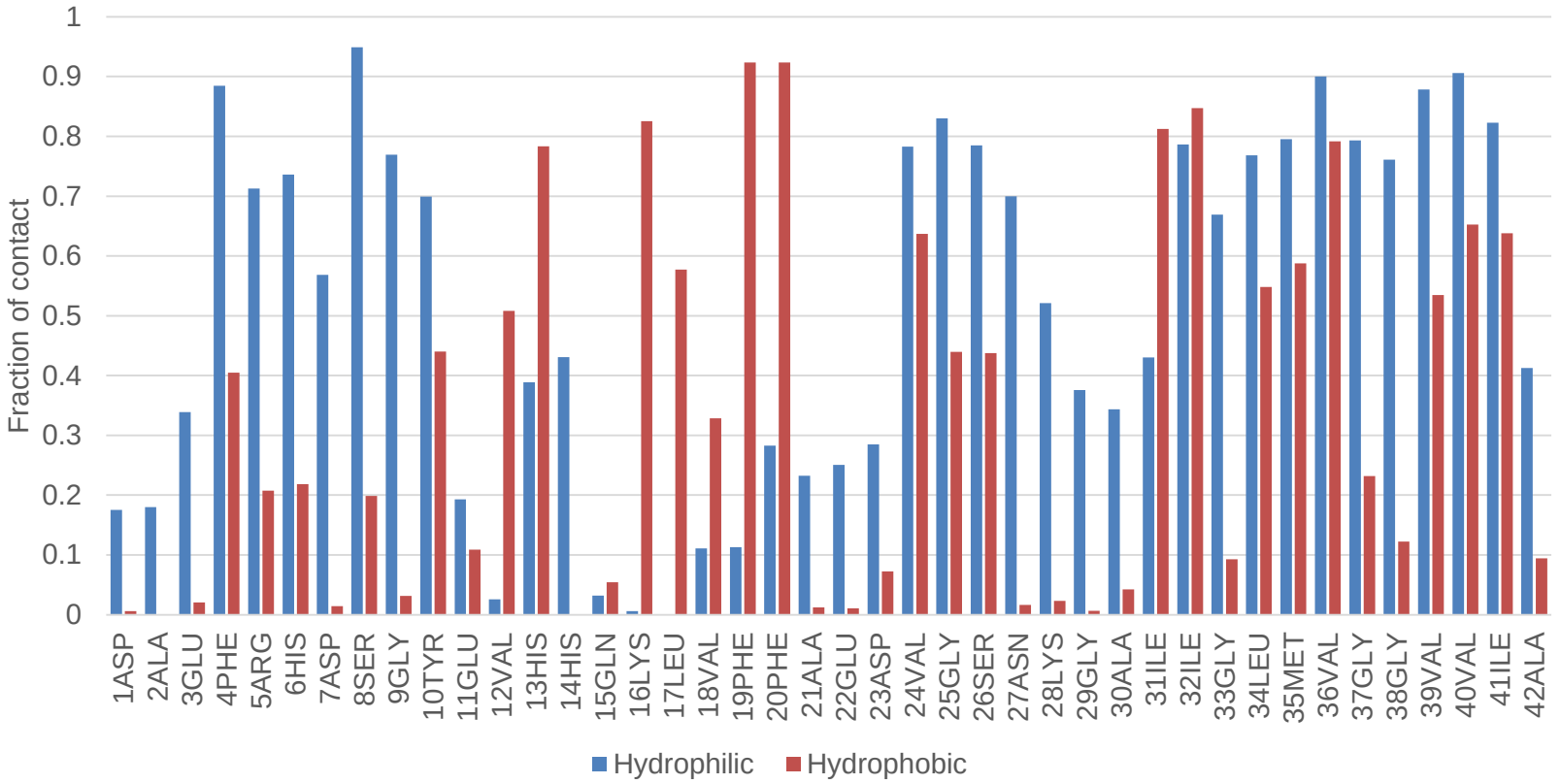
Structure – radius of gyration



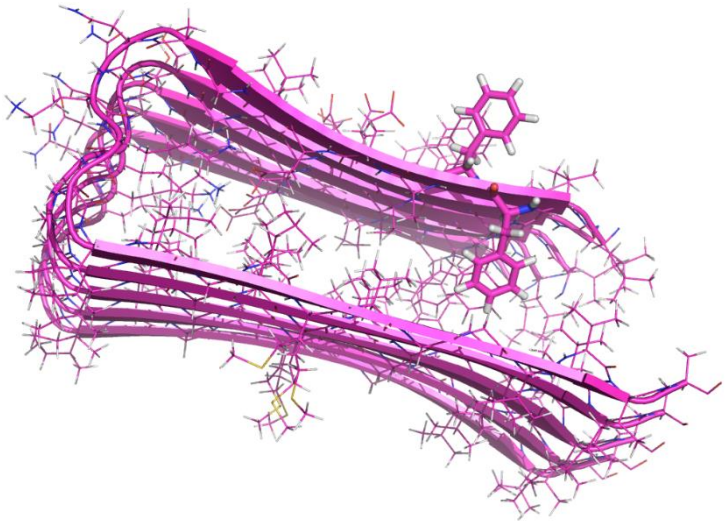
Radius of gyration and its components for the protein. Error bars show the distribution.

Contacts of different residues

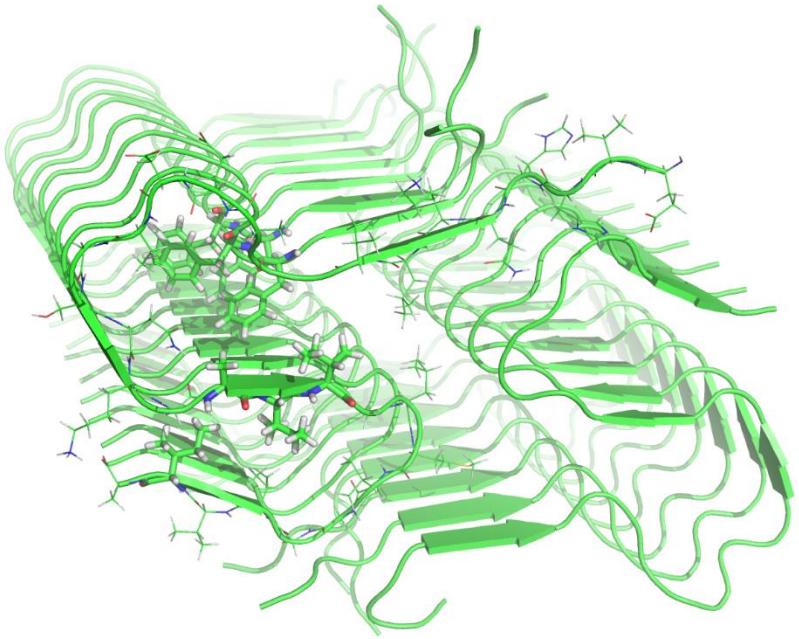
- Hydrophobic C-Dot interact with the residues that form the core
- Hydrophilic C-Dot interact with more residues and facilitate a more extended structure



Hydrophobic core in fibril



Aβ17-42 core



Aβ11-42 core

Conclusion

- C-Dots can inhibit fibrillation mainly due to its hydrophilic surface
- The hydrophilic surface interacts with most of the residues and induce an extended structure; In contrast, the hydrophobic surface promotes a more compact structure
- It is postulated that the extended protein conformation on the C-Dot is unfavorable for protein aggregation.