**Highlights**

* Tat causes ~1-2 Å average thinning of three membrane mimics
* Local thinning near Tat is ~3 Å determined by MD simulations of DOPC/Tat
* Tat increases area/lipid by ~3-5 Å2 and softens membranes
* Tat decreases chain order and increases mosaic spread
* A structural pore formed by Tat is not supported by this study