

## I. CRITICAL CLUSTER

In this section, we show the performed trajectories done for the TIP4P and mW water models to establish in what degree of supercooling the cluster inserted becomes critical. The performed trajectories for the TIP4P/2005 and TIP4P/ICE water models for the same purpose are shown in the Supplementary material of Ref [E. Sanz, C. Vega, J. R. Espinosa, R. Caballero-Bernal, J. L. F. Abascal and C. Valeriani, JACS, **135**, 15008, (2013)].

TABLE I.  $N_t$  is the total number of molecules in the system (ice cluster + surrounding liquid water molecules) and  $N_c$  is the number of molecules of the inserted spherical ice cluster after equilibration of the interface.

$N_t$	$N_c^{TIP4P/2005}$	$N_c^{TIP4P/Ice}$	$N_c^{TIP4P}$	$N_c^{mW}$
22712	600	600	600	600
76781	3170	3167	3170	3167
182585	7931	7926	7931	7926

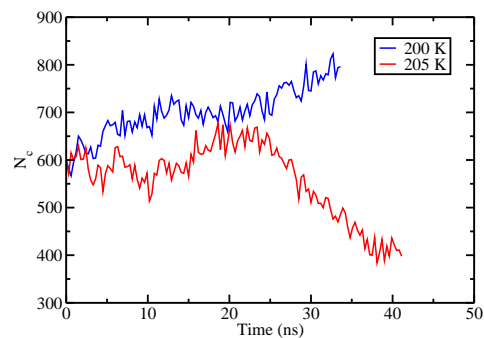


FIG. 1. Performed trajectories for the cluster of 600 ice molecules for the TIP4P model. The temperature for which this cluster is critical is 202.5 K.

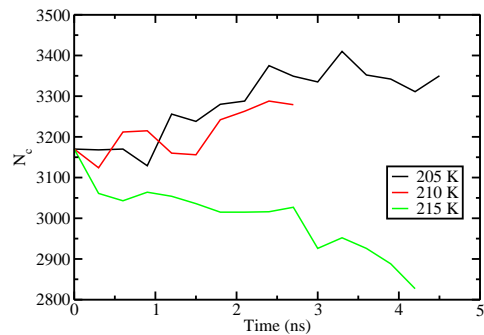


FIG. 2. Performed trajectories for the cluster of 3170 ice molecules for the TIP4P model. For this cluster size, the critical temperature is 212.5 K

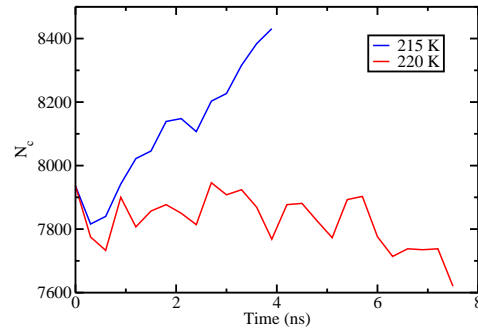


FIG. 3. Performed trajectories for the cluster of 7931 ice molecules for the TIP4P model. In this case the critical temperature is 217.5 K.

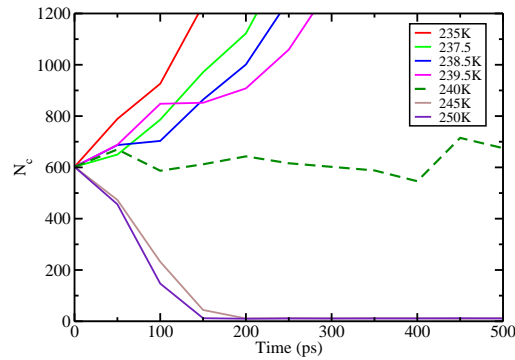


FIG. 4. Performed trajectories for the cluster of 600 ice molecules for the mW model. The temperature for which this cluster is critical is 240 K.

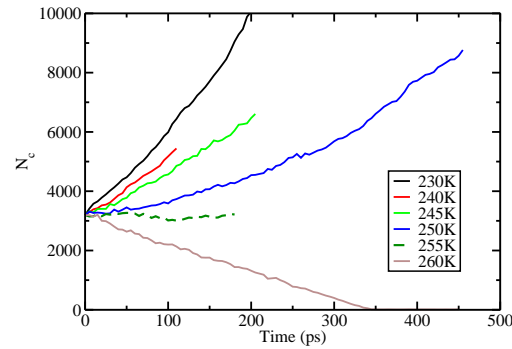


FIG. 5. Performed trajectories for the cluster of 3167 ice molecules for the mW model whose critical temperature is 255 K.

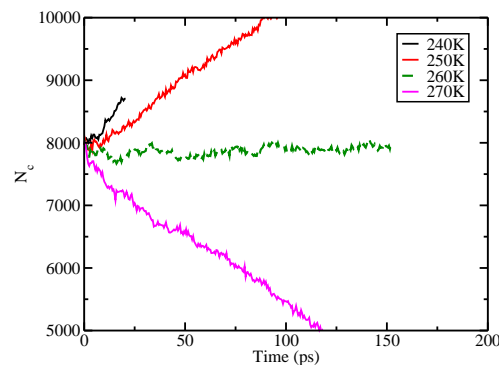


FIG. 6. Performed trajectories for the cluster of 7926 ice molecules for the mW model. The temperature for which this cluster is critical is 260 K.

## II. ATTACHMENT RATES

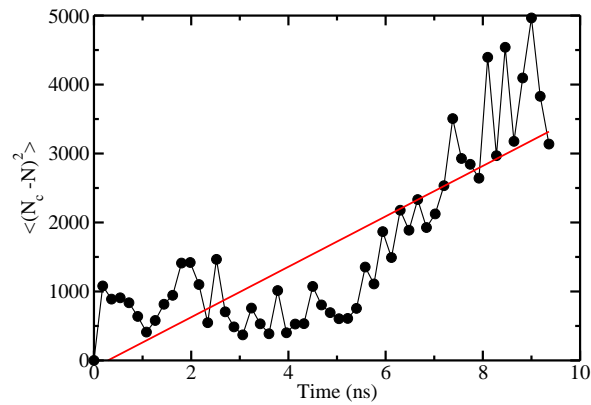


FIG. 7. Attachment rate calculated for the cluster of 600 ice molecules for the TIP4P model. 10 trajectories were performed under conditions of  $T=202.5$  K and  $P=1$ bar.

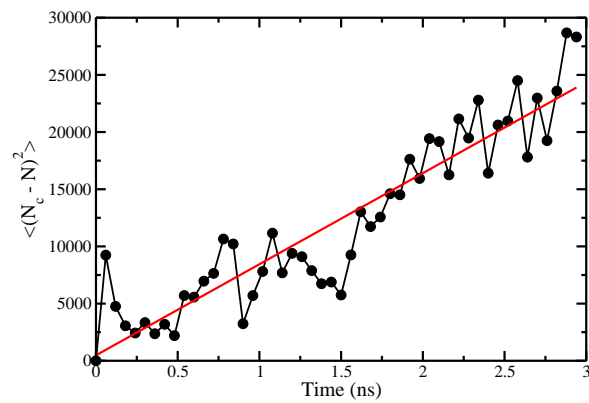


FIG. 8. Attachment rate calculated for the cluster of 3170 ice molecules for the TIP4P model. 10 trajectories were performed under conditions of  $T=212.5$  K and  $P=1$ bar.

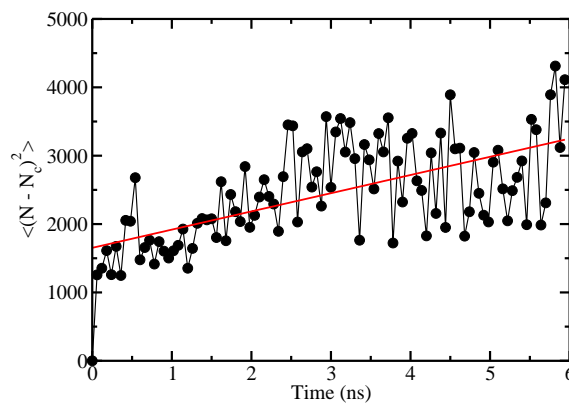


FIG. 9. Attachment rate calculated for the cluster of 600 ice molecules for the TIP4P/2005 model. 10 trajectories were performed under conditions of  $T=222.5$  K and  $P=1$ bar.

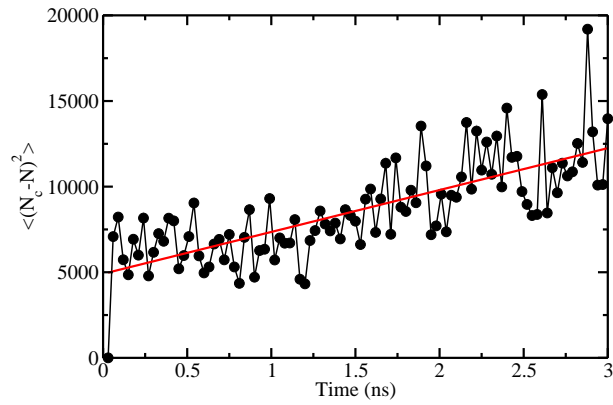


FIG. 10. Attachment rate calculated for the cluster of 3170 ice molecules for the TIP4P/2005 model. 10 trajectories were performed under conditions of  $T=232.5$  K and  $P=1$ bar.

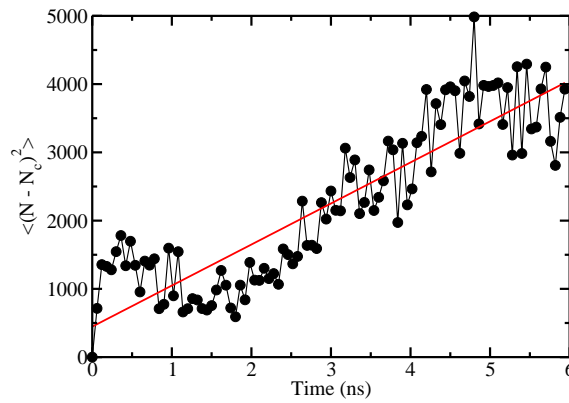


FIG. 11. Attachment rate calculated for the cluster of 600 ice molecules for the TIP4P/ICE model. 10 trajectories were performed under conditions of  $T=237.5$  K and  $P=1$ bar.

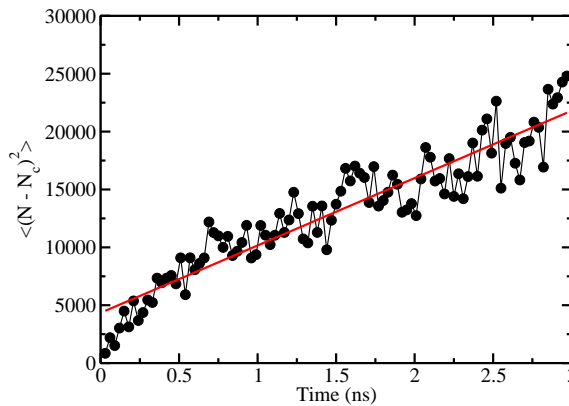


FIG. 12. Attachment rate calculated for the cluster of 3167 ice molecules for the TIP4P/ICE model. 10 trajectories were performed under conditions of  $T=252.5$  K and  $P=1$ bar.

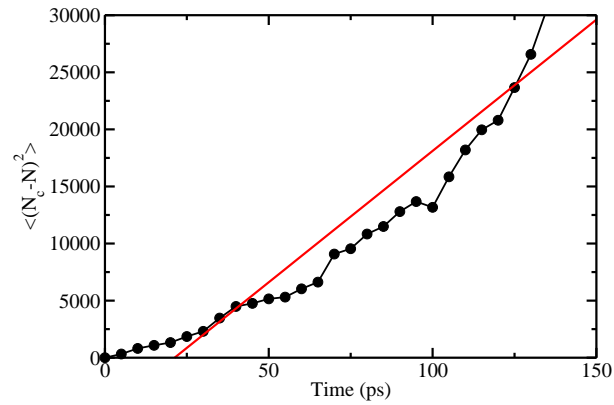


FIG. 13. Attachment rate calculated for the cluster of 600 ice molecules for the mW model. 30 trajectories were performed under conditions of  $T=240$  K and  $P=1$ bar.

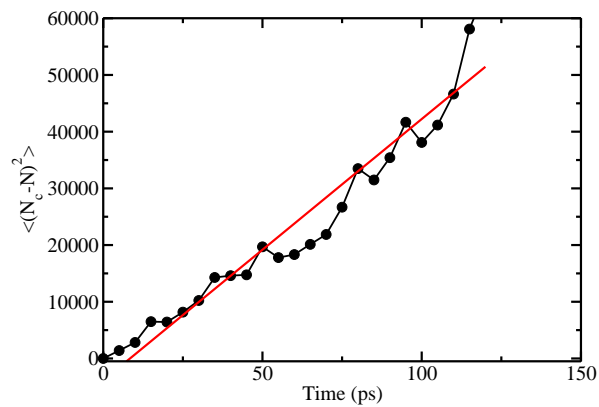


FIG. 14. Attachment rate calculated for the cluster of 3167 ice molecules for the mW model. 30 trajectories were performed under conditions of  $T=255$  K and  $P=1$ bar.

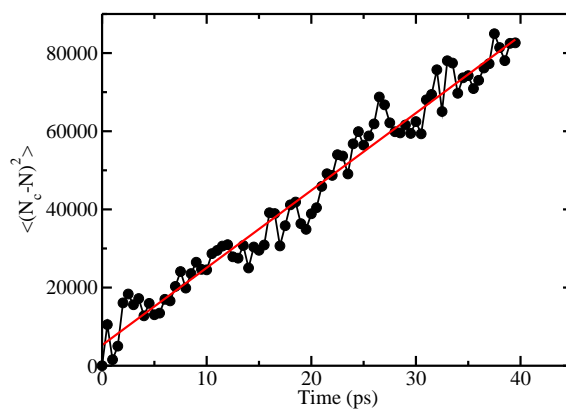


FIG. 15. Attachment rate calculated for the cluster of 7926 ice molecules for the mW model. 30 trajectories were performed under conditions of  $T=260$  K and  $P=1$ bar.