Supplementary information

Structural dynamics of mixed-subunit CaMKIIα/β heterododecamers filmed by high-speed AFM

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Supplementary Video legends

Supplementary Video 1. HS-AFM videos of three representative CaMKIIβ homooligomers on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Image size, 360 × 98 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 68 or 69 nm^2; frame rate, 3.3 fps.

Supplementary Video 2. HS-AFM videos of three representative CaMKIIβ homooligomers with 50 μM bosutinib on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Image size, 240 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 nm^2; frame rate, 3.3 fps.

Supplementary Video 3. HS-AFM videos of three representative CaMKIIα/β 3:1 heterooligomers on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Green arrowheads indicate the kinase domains of CaMKIIβ subunits. Image size, 240 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 nm^2; frame rate, 3.3 fps.

Supplementary Video 4. HS-AFM videos of three representative CaMKIIα/GFP-CaMKIIβ 3:1 heterooligomers on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Green arrowheads and arrows indicate the kinase domains of CaMKIIβ subunits and GFP, respectively. Image size, 120 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 nm^2 or 100 × 80 nm^2; frame rate, 3.3 fps.

Supplementary Video 5. HS-AFM videos of three representative CaMKIIβ homooligomers treated with Ca^{2+}/CaM (1 mM Ca^{2+} and 800 nM CaM) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. White dotted circles indicate Ca^{2+}/CaM bound to the kinase domains, and blue dotted squares indicate kinase domain complexes. Image size, 360 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 82 or 80 nm^2; frame rate, 3.3 fps.

Supplementary Video 6. HS-AFM videos of three representative CaMKIIα/β 3:1 heterooligomers treated with Ca^{2+}/CaM (1 mM Ca^{2+} and 800 nM CaM) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Green arrowheads indicate the kinase domains of CaMKIIβ subunits. White dotted circles indicate Ca^{2+}/CaM bound to the kinase domains, and blue dotted squares indicate

kinase domain complexes. Image size, 240 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 nm^2; frame rate, 3.3 fps.

Supplementary Video 7. HS-AFM videos of three representative CaMKIIβ homooligomers treated with Ca^{2+}/CaM and ATP (1 mM Ca^{2+}, 800 nM CaM, and 1 mM ATP) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. White dotted circles indicate Ca^{2+}/CaM bound to the kinase domains, and blue dotted squares indicate kinase domain complexes. Image size, 360 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 77, 72 or 76 nm^2; frame rate, 3.3 fps.

Supplementary Video 8. HS-AFM videos of three representative CaMKIIα/β 3:1 heterooligomers treated with Ca^{2+}/CaM and ATP (1 mM Ca^{2+}, 800 nM CaM, and 1 mM ATP) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Green arrowheads indicate the kinase domains of CaMKIIβ subunits. White dotted circles indicate Ca^{2+}/CaM bound to the kinase domains, and blue dotted squares indicate kinase domain complexes. Image size, 240 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 or 100 × 80 nm^2; frame rate, 3.3 fps.

Supplementary Video 9. HS-AFM videos of three representative CaMKIIβ homooligomers treated with EGTA (2 mM) and ATP (1 mM) after Ca^{2+}/CaM/ATP stimulation (1 mM Ca^{2+}, 800 nM CaM, and 1 mM ATP) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Blue dotted squares indicate kinase domain complexes. Image size, 360 × 96 or 80 × 73 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 74 or 73 nm^2; frame rate, 3.3 fps.

Supplementary Video 10. HS-AFM videos of three representative CaMKIIα/β 3:1 heterooligomers treated with EGTA (2 mM) and ATP (1 mM) after Ca^{2+}/CaM/ATP stimulation (1 mM Ca^{2+}, 800 nM CaM, and 1 mM ATP) on a P[5]A+-modified mica surface. The trajectories of the kinase domains are shown on the right. Green arrowheads indicate the kinase domains of CaMKIIβ subunits. Blue dotted squares indicate kinase domain complexes. Image size, 240 × 96 or 120 × 96 pixels^2 (acquired in HS-AFM observations); scan area, 80 × 64 nm^2; frame rate, 3.3 fps.

Supplementary Video 11. HS-AFM videos of CaMKIIα$_{T286A}$ and CaMKIIβ$_{T287A}$ homooligomers treated with Ca^{2+}/CaM (1 mM Ca^{2+} and 800 nM CaM) on a P[5]A+-modified mica surface. An enlarged view of the white dotted box is presented on the right. White dotted circles indicate Ca^{2+}/CaM bound to the kinase domains, and white dots indicate the center of the kinase domains. Frame rate, 3.3 fps.