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Modification of 2D Silica Bilayer Structure via Strain and Al Doping CHAO ZHOU, JIN-HAO JHANG, GREGORY HUTCHINGS, OMUR DAGDEVIREN, ANDREI MALASHEVICH, UDO SCHWARZ, SOHRAB ISMAIL-BEIGI, ERIC ALTMAN, Yale Univ — The preparation of 2D silicate bilayers on metal substrates in crystalline and amorphous forms paves the way to creating a multitude of 2D structures. We study strain effects on the bilayer structure using $Ni_xPd_{1-x}(111)$ films which allow continuous strain tuning from 6.0% compressive to 3.8% tensile. The interaction with the substrate and its atomic spacing and geometry determines the lattice strain exerted. Previously, a commensurate hexagonal crystalline bilayer was observed on Ru(0001) with a tensile mismatch of 2.2%, while only amorphous bilayers were seen on Pt(111) (4.7% tensile mismatch) and uniaxial strain on Pd(100) led to a commensurate crystalline phase with arrays of domain boundaries. Theory indicates that biaxial tensile strain above 2.5% favors the introduction of 8-membered rings into the bilayer. Experiments show that SiO_2 bilayers grow in an incommensurate crystalline form on Pd(111) (x=0) which sets the maximum biaxial tensile strain to <3.8%. Meanwhile, $AlSi_3O_8$ thin films formed a commensurate crystalline film on Pd(111). Theory shows that the longer Al-O bonds reduce the strain energy by decreasing the mismatch to 1.9%, explaining the transition from incommensurate to commensurate. Ongoing work on $Ni_xPd_{1-x}(111)$ is determining the maximum lattice strain that can be applied for controllable introduction of 8-membered rings into the structure.

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