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State-to-State Surface Scattering of Methane RAINER BECK, MAARTEN E. VAN REIJZEN, JOERN WERDECKER, Ecole Polytechnique Federale de Lausanne — We report first results for state-to-state surface scattering experiments for CH_4. A molecular beam of CH_4, incident on a single crystal Ni(111) surface, is prepared in a single rovibrationally excited quantum state by infrared pumping using a continuous wave optical parametric oscillator. State prepared $CH_4(\nu_3, J=2)$ collides with the Ni surface with controlled incident energy and angle and the scattered CH_4 molecules are detected with quantum state resolution using a cryogenic bolometer in combination with infrared laser tagging. Using this setup, we measured rotational and vibrational state distributions for methane scattered from bare Ni(111), graphene covered Ni(111), and LiF(100). The results provide detailed information on the rotational and vibrational energy transfer between the incident $CH_4(\nu_3, J=2)$ molecules and the target surface. Efficient vibrational energy transfer is observed for incident $CH_4(\nu_3)$ leading to scattered $CH_4(\nu_1)$ where ν_3 and ν_1 are the anti-symmetric and symmetric C-H stretch normal modes of CH_4, respectively. Energy transfer probabilities to other vibrational states of CH_4 including the vibrational ground state are currently under investigation and will be reported in this contribution.

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