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The electronic structure of S-layer proteins from Lactobacillus brevis

Bacterial S-layers present an interesting composite material to study. S-layers are crystalline outer-sheaths of some bacteria that consist of a number of proteins. Unit cells are essentially two-dimensional with lattice parameters that are in the order of nanometers. This study attempts to detail the electronic structure from one particular bacterium, Lactobacillus brevis. L. brevis is a rod-shaped gram-positive bacterium from the family of lactic acid bacteria, Lactobacillaceae, that are involved in the fermentation process creating CO2 and lactic acid. Clearly the surface of such bacteria must play a huge role in such heterogeneous fermentation processes. The valence electronic structure of the S-layer of L. brevis is determined using synchrotron-based photoelectron spectroscopy and soft x-ray absorption spectroscopy. Spectra are compared to experimental work on amino-acids and S-layers of Bacillus sphaericus. While indeed possible to identify energy levels with those of natural amino-acids, distinct energy shifts are observed which cannot be reconciled using such simple comparisons. Furthermore a strong nitrogen signal observed in both the occupied and unoccupied energy levels suggests that the L. brevis protein is amine-terminated on the S-layer surface. The presence of amine termination suggests decarboxylase activity related to the fermentation process.

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