

Tight-binding model on a ribbon

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We consider 2D tight-binding model on a ribbon with hopping anisotropy. The goal is to study the corresponding one-particle eigenvalue problem and the possible formation of edge states. The problem is reduced to a 5-term recurrence relation. The comprehensive analytic study on an entire Brillouin zone is a nontrivial task, and we concentrate on two special values of the quasimomentum: $k=0$ and $k=\pi$. For these particular cases we have carried out analytic calculations and have found the corresponding phase diagrams where from it follows that the system can be found in three different phases. These are: 1) simultaneous occurrence of two edge states with two different scales of penetration depth; 2) simultaneous occurrence of two different bulk states and 3) simultaneous occurrence of one edge state and one bulk state.