

Phase controlled synthesis of 2D-MTe₂ (M=Mo, Ir) on epitaxial graphene

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Transition metal chalcogenides (TMCs) have been the subject of increasing interest for the condensed matter community in the past years. Among TMCs are those with a stoichiometry MTe₂, where M is a transition metal (groups IV-X), the so-called transition metal ditellurides (TMDTs) [1]. TMDTs show a very rich landscape of physical properties that depends not only on the transition metal but also on their thickness and crystallographic structure. For instance, the semiconducting hexagonal phase of MoTe₂ shows an indirect band gap in the bulk (2H phase) or a direct band gap at the monolayer (1H) [2] while its distorted octahedral phase (1T') is a three-dimensional topological Weyl semimetal predicted to exhibit quantum spin Hall (QSH) effect at the monolayer thickness [3]. Another example is the metastable 1T-IrTe₂ phase, which suffers structural phase transitions showing a competition between charge ordering and superconductivity that depends on its thickness [4]. Phase control has in fact emerged as an interesting approach to tune the properties of TMDTs [5].

Here, we report the growth of 2D islands of MoTe₂ and IrTe₂ via molecular beam epitaxy (MBE) on epitaxial graphene over Ir(111) (Fig. 1(a)). We demonstrate great control of the formation of their different structural phases (Fig. 1(c), 1(d) and 1(g)) by varying the substrate temperature (Fig. 1(b)) or tuning the Te:M ratio during growth (Fig. 1(e)). Their structural and electronic characteristics are studied by means of scanning tunneling microscopy (STM).

References

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Figures

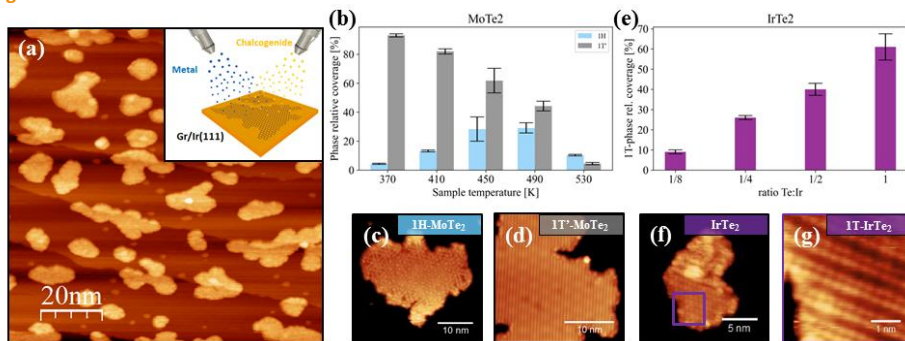


Figure 1: (a) Large STM image of IrTe₂ islands grown on gr/Ir(111) ($V=-1V$; $I=0.1nA$). Inset shows a sketch of the growth procedure. (b) Barplot shows the relative coverage of 1T' and 1H-MoTe₂ phases at different growth temperatures. STM images of (c) 1H-MoTe₂ ($V=0.5V$; $I=0.1nA$) and (d) 1T'-MoTe₂ islands ($V=1V$; $I=0.1nA$). (e) Barplot shows the relative coverage of 1T-IrTe₂ for different Te:Ir ratios. (f) STM image of an IrTe₂ island ($V=-1V$; $I=0.1nA$). (g) Close-up showing 1T-IrTe₂ dimerization ($V=-0.2V$; $I=0.7nA$).