We demonstrate an approach that provides a precise control of the dimension of InAs from one-dimensional (1-D) nanowires to wafer-scale free-standing two-dimensional (2-D) nanosheets, which have a high degree of crystallinity, using molecular-beam epitaxy by controlling catalyst alloy segregation. In our approach, 2-D InAs nanosheets can be obtained directly from 1-D InAs nanowires by silver-indium alloy segregation, which is much easier than all previously reported method, such as traditional buffering technique and select area epitaxial growth. Detailed transmission electron microscopy investigations provide a solid evidence that the catalyst alloy segregation is the origination of the InAs dimensional transformation from 1-D nanowires to 2-D nanosheets, and even to three-dimensional complex crosses. Using this method, we find that the wafer-scale free-standing InAs nanosheets can be grown on various substrates including Si, MgO, sapphire and GaAs etc. The InAs nanosheets grown at high temperature are pure phase single crystals. Our work will open up a conceptually new and general technology route toward the effective controlling the dimension of the low-dimensional III–V semiconductors. It may also enable the low-cost fabrication of free-standing nanosheet-based devices on an industrial scale.