**Raw Data and Data processing**

Raw data for ultraviolet–visible spectroscopy, photoluminescent and ultraviolet photoelectron spectroscopy has been uploaded for data transparency. All the data was plotted using Origin 9.1. The project files for data processing and data plotting have also been uploaded. To combine the plotted data into a manuscript figure, Adobe Illustrators were used for adjusting the layout. Below shows some important information for data processing in this work:

**Data for Fig 2a\_2b:**

Ultraviolet photoelectron spectroscopy was taken by AXIS Supra by Kratos Analytical from UC Irvine Materials Research Institute and was operated by Dr. Ich Tran.

**Data processing for UPS has been clearly demonstrated in Supplementary information.**