Semilogarithmic Current-Voltage Relationship of Photoelectrodes for Water Splitting

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Abstract. The physical fundamentals of photovoltaic and photoelectrochemical cells for conversion of solar energy are similar. Although it is common to report semi-logarithmic current-voltage measurements for photovoltaic cells to judge the quality of the rectifying semiconductor junction, such habit is rather uncommon in the literature on photoelectrochemical cells. In this review, we highlight the available literature and data on semi-logarithmic current-voltage measurements for oxygen evolution reaction or hydrogen evolution reaction on semiconductor photoelectrodes. We show that exchange current density of semiconductor/electrolyte interface can be extracted from the semilogarithmic dark current-voltage plot. As exchange current density determines the photovoltage of the photoelectrode, its extraction is very important for improvement of the photoelectrodes. The ideal photoelectrode theoretically shows a diode-like photocurrent typical of the rectifying junction (Tafel slope 56 mV per decade). However, the surveyed literature presents a broad span of Tafel slopes highlighting the complexity of photoelectrode processes in comparison with the ideal model. This work aims to provide arguments and suggestions for reporting semilogarithmic current-voltage plots during the quest for efficient photoelectrodes.