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OPTOELECTRONIC FLEXIBLE DEVICES BASED ON WS2 EXFOLIATED BY LITHIUM INTERCALATION

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ABSTRACT

Alternative sources of energy have become crucial in the current environmental crisis. For example, converting strain, a temperature difference, or light into electrical current in materials supported on flexible substrates manages to reduce CO_2 emissions compared to traditional optoelectronic materials [1-3]. Moreover, when those materials, that exhibit optoelectronic characteristics, are low dimensional, the response increases considerably in contrast with their bulk counterpart [2]. For example, when transition metal dichalcogenides (TMDs) are exfoliated to obtain monolayers, their bandgap changes from an indirect transition to a direct one, thus enhancing the photocurrent [4]. The purpose of our study is to develop and measure optoelectronic flexible devices based on tungsten disulfide (WS_2). This is done by exfoliating WS_2 via lithium intercalation and then printing WS_2 on paper. The fabrication of optoelectronic devices was achieved, managing to reach sensibilities of over $10\ \%$ of dark conductivity and responsivities over $20\ \mu AW^{-1}$. This research will lead to the production of efficient optoelectronic flexible devices based on TMDs.

WS2 EXFOLIATED BY LITHIUM INTERCALATION

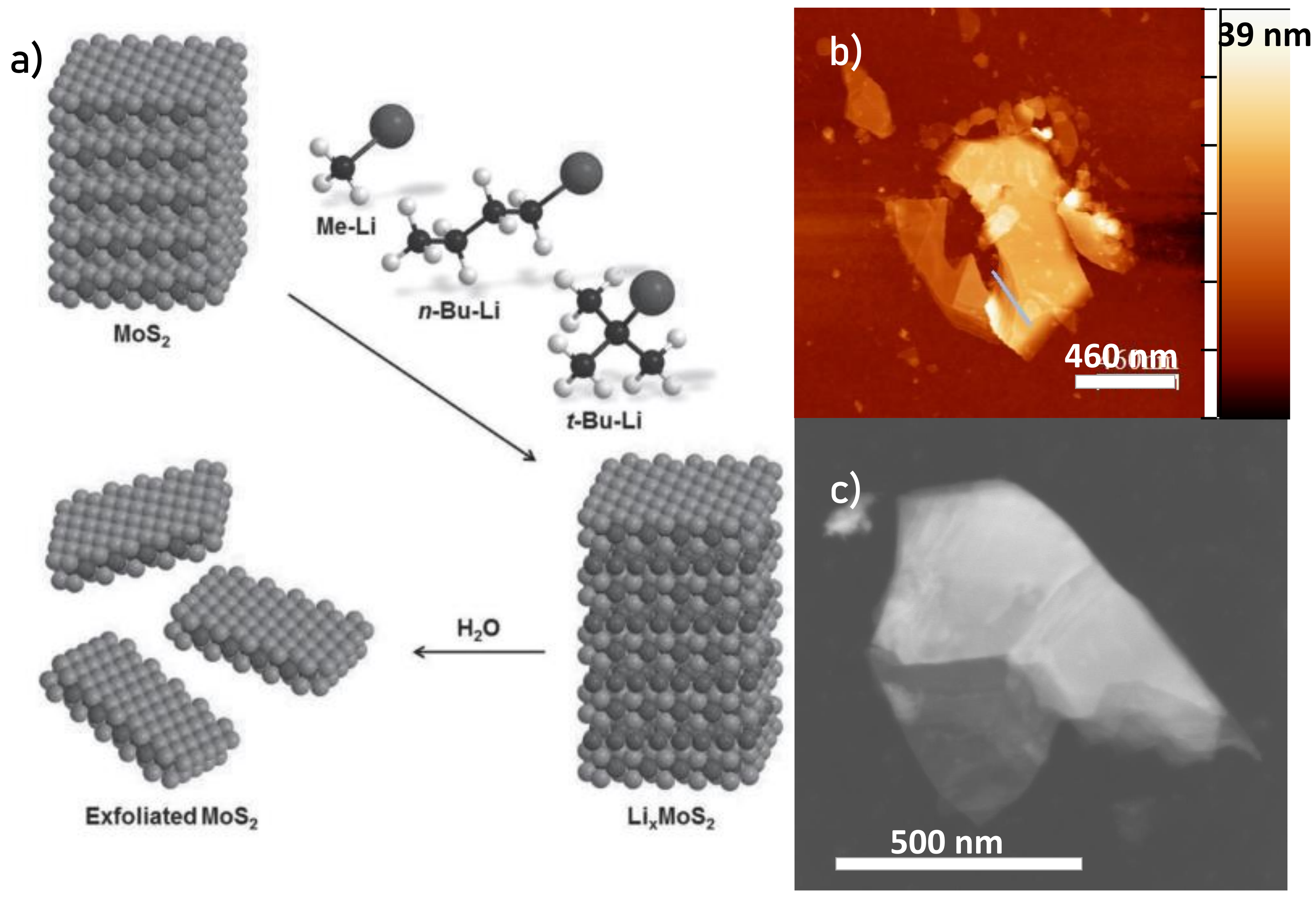

Fig 1. a) Lithium intercalation scheme. b), c) AFM and SEM graphs of a crystal exfoliated on the 1st and 2nd lithium intercalation.

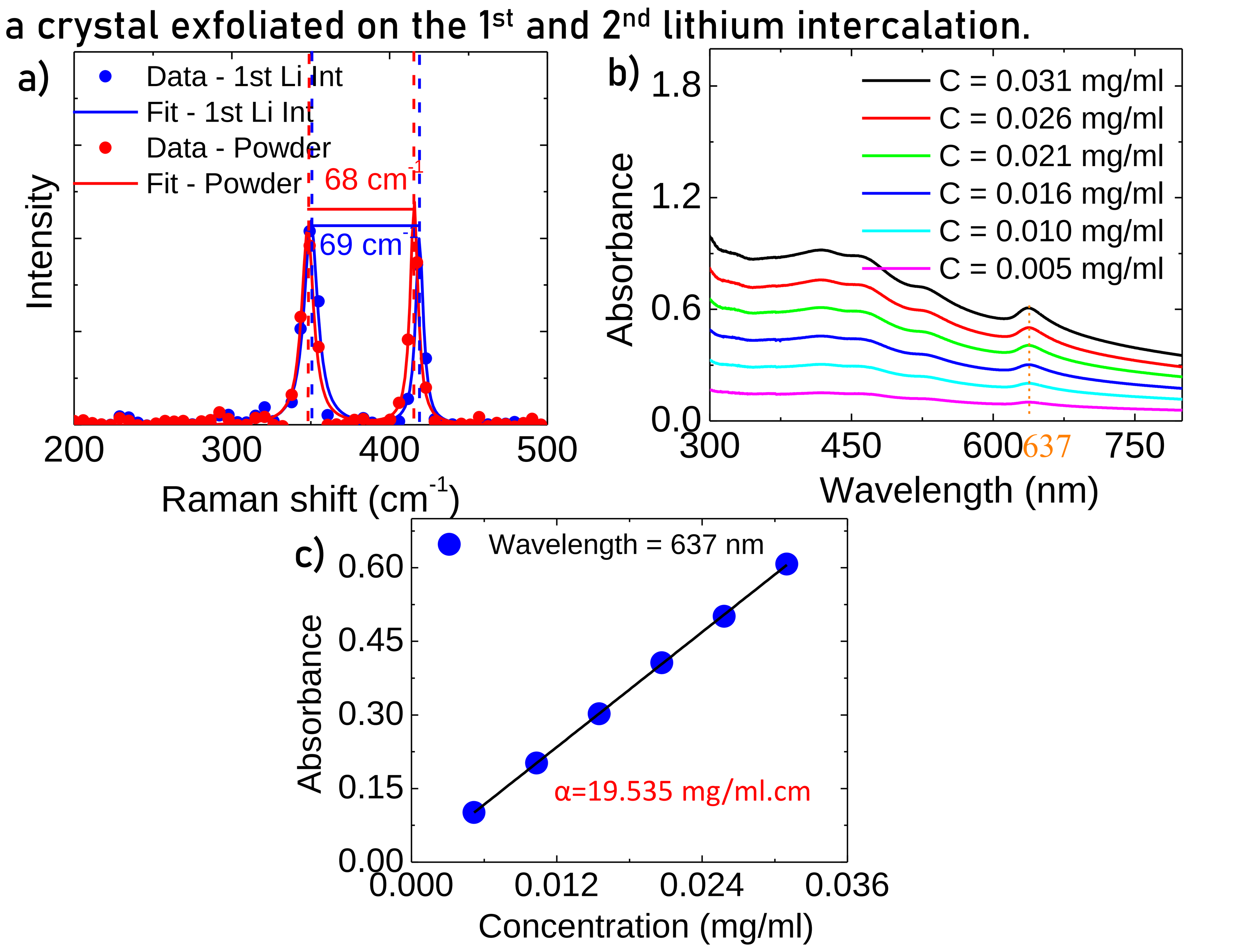

Fig 2. a) Raman signature of WS_2. b) UV-Vis spectrum of dispersions of different concentrations of WS_2 c) Bier-Lambert law to obtain α.

PHOTOCONDUCTIVITY ON FLEXIBLE DEVICES BASED ON WS2

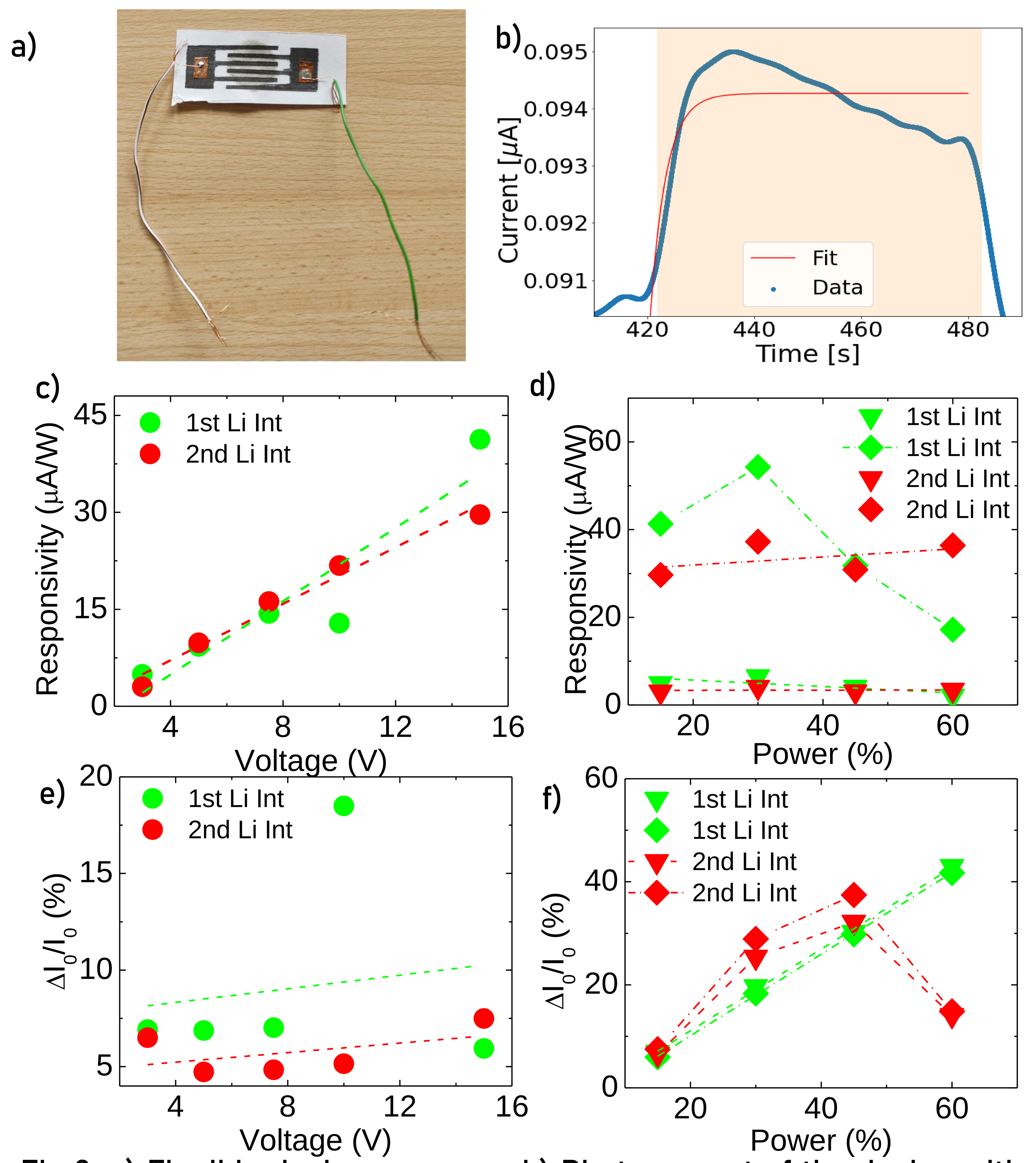

Fig 3. a) Flexible device on paper. b) Photocurrent of the device with an exponential fit. Responsivity for devices made of 1st and 2nd intercalation as a function of c) voltage and d) power of the lamp (diamond and triangle means 15 V and 3 V of bias voltage). Sensibility for those devices as a function of e) voltage and f) power.

CONCLUSIONS AND OUTLOOK

Tungsten disulfide crystals of different sizes are obtained via lithium intercalation. Flexible devices based on exfoliated crystals are produced and their photoconductivity is characterized as a function of voltage, power and number of repetitive lithium intercalations.

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