# Stability study of CVD-grown $WS_2$ under high-temperature annealing

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In recent years, transition metal dichalcogenides (TMDs) have attracted increasing interest for several applications, such as valleytronics [1] or optoelectronics [2]. This large interest is due to their unique electrical and optical properties, together with their tendency to grow as monolayers under suitable growth conditions. However, although much has been published about their structural, optical and electrical properties, only a few studies about their stability in different environments [3] or on the dependence of their performance over time [4] have been reported.

With the aim to fill partially this gap, the stability of CVD-grown $WS_2$, annealed at temperatures between 300 °C and 600 °C and at pressure of $10^{-3}$ mbar, has been investigated. In this work, the structural, compositional and optical properties have been monitored using different techniques, such as Raman, PL and XPS spectroscopies.

From the results reported in this study, it is evident that high-temperature annealing causes the degradation of $WS_2$ optical properties, both via generation of non-radiative centres, due to aggregation of point defects, and via loss of sulphur atoms, due to oxygen substitution. In addition, the rate of this degradation has been found strictly dependent on the temperature at which the annealing takes place.

From these results, it can be concluded that CVD-grown $WS_2$ is not suitable for high-temperature applications and, before any handling of the material, its instability at high temperatures must be taken into account.

## References

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## Figure

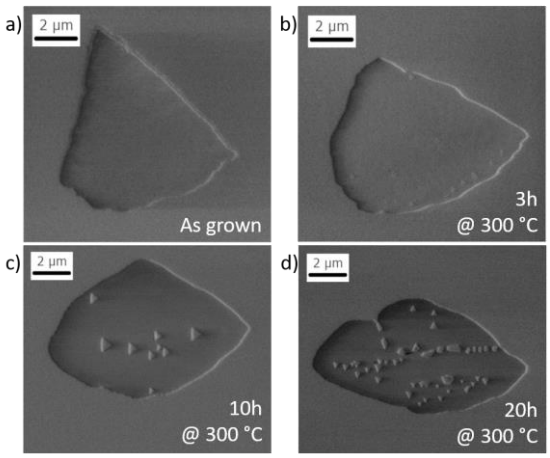


**Figure 1:** $WS_2$ flake as grown (a) and after annealing at 300°C for 3 (b), 10 (c) and 20 h (d).

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