Laser patterning of the room temperature van der Waals ferromagnet 1T-$CrTe_2$
Supplemental Material

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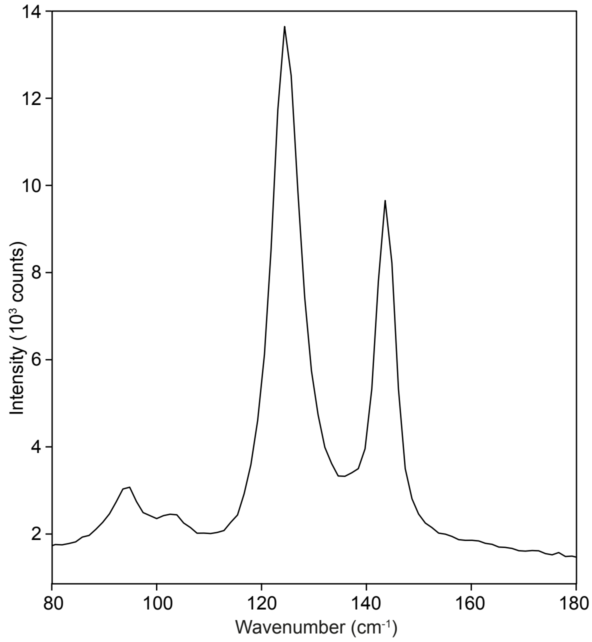

FIG. S1. Raman scattering spectrum measured with 0.3 mW laser power for a 30 nm-thick $1T$-$CrTe_2$ flake on SiO_2/Si at room temperature, after laser irradiation with a 3 mW laser power.

Figure S1 shows a Raman scattering spectrum of a $1T$-$CrTe_2$ flake after it has been irradiated with a 3 mW laser beam. The measurement is here performed at room temperature, with a moderate laser power to avoid substantial heating of the flake. The spectrum looks very similar to those reported in the main text Fig. 1(a) (laser powers of 2 mW and above) and Fig. 3(c) (orange curve, laser power of 3 mW), proving the irreversibility of the laser-induced changes occurring above a certain laser power.

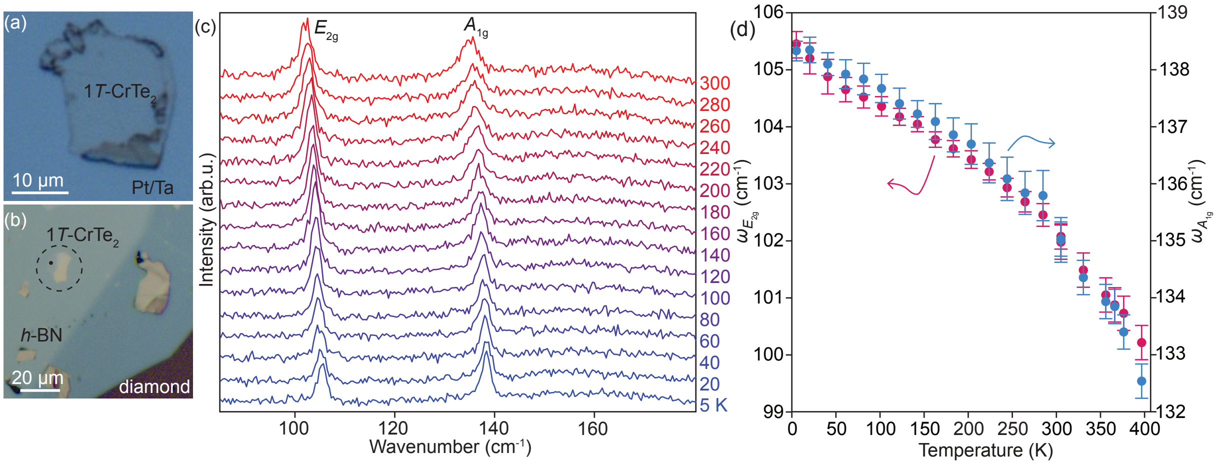

FIG. S2. (a,b) Optical micrographs of the two studied samples, one with a ∼100 nm thickness deposited on a Pt/Ta/Si substrate (a), the other with a ∼20 nm thickness (black spot in the flake highlighted with a dotted circle) deposited on *h*-BN/diamond (b). (c) Raman scattering intensity for different temperatures from 5 K to 300 K (laser power 0.6 mW). Curves are vertically shifted for clarity. (d) Variations of the central wavenumber of the Raman E_{2g} and A_{1g} modes, $\omega_{E_{2g}}$ and $\omega_{A_{1g}}$, extracted from (c). Note that the measurements from which the data are extracted were performed with two different experimental setups and samples in the 5 K-300 K (0.6 mW laser power) and in the 300 K-390 K (0.3 mW laser power) ranges.

Besides the experimental data in the main text, we studied flakes in a more extended range of temperature. Two flakes were exfoliated on two different substrates, *h*-BN and Pt/Ta (Fig. S2a,b), and their Raman scattering spectra were recorded, using two different experimental setups, in two different temperature ranges (5 K-300 K and 300 K-390 K). The $\leq$300 K data are represented in Fig. S2c. The central wavenumbers $\omega_{E_{2g}}$ and $\omega_{A_{1g}}$ of the two peaks characteristic of 1T-$CrTe_2$ (E_{2g} and A_{1g} modes) are extracted from fits of the Raman scattering spectra at the different temperatures, and represented in Fig. S2d. There, the $\omega_{A_{1g}}$ data measured with the above-room-temperature setup have been shifted by -1.8 cm^{-1} (the origin for this shift, needed for the data to be continuous below/above 300 K and applied to $\omega_{A_{1g}}$ but not to $\omega_{E_{2g}}$, may relate to an imperfect wavenumber calibration of the spectrometer or optical alignment / collimation in this particular experiment). The central wavenumbers red-shift with a slope that progressively increases (in absolute numbers) as temperature increases, by about 50% over the explored range.

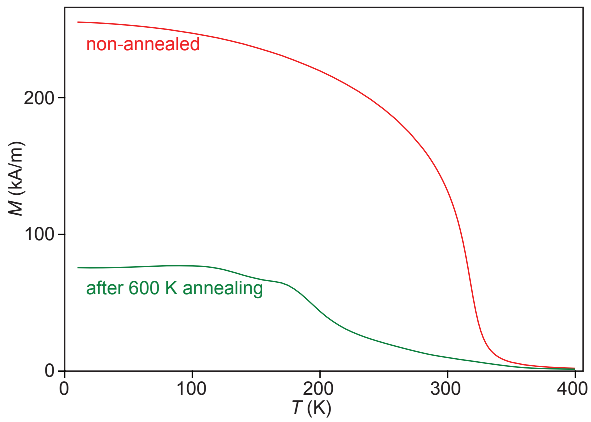

FIG. S3. Magnetization measured with VSM-SQUID as function of temperature (T), with a 0.5 T field applied in-plane, for a mm-sized sample, pristine $1T$-$CrTe_2$ and for the transformed material after a 600 K annealing for 30 min.

Figure S3 shows magnetometry data measured using a vibrating sample magnetometer with a VSM-SQUID for a macroscopic grain of the starting (bulk) material, before and after 600 K annealing for 30 min. An external magnetic field is applied in the plane of the layers. A clear decrease of the magnetic ordering temperature is observed, from above to below 300 K, consistent with a previous report [S1].

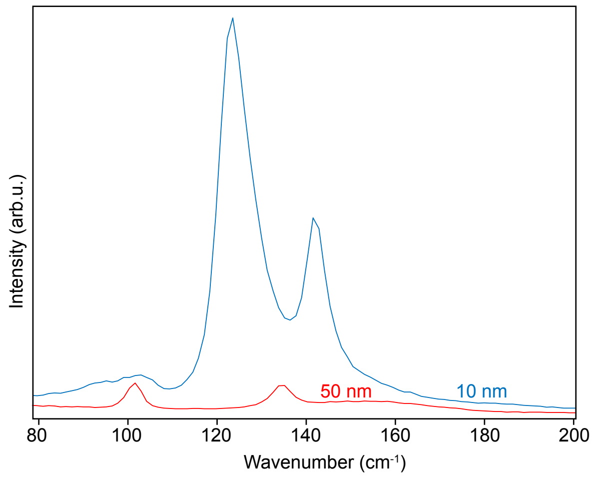

FIG. S4. Raman scattering spectra of two flakes placed on a SiO_2/Si substrate, with 10 nm and 50 nm thickness, both measured with a 0.3 mW laser power at room temperature in air.

Figure S4 shows two Raman scattering spectra acquired in the same conditions (in particular, laser power of 0.3 mW) for two different flakes deposited on a SiO_2/Si substrate. Only the thickest flake exhibits the characteristic signature of pristine 1T-$CrTe_2$, while the thinnest flake has the signature of a Cr-Te compound with Cr/Te ratio greater than 1/2.

[S1] A. Purbawati, S. Sarkar, S. Pairis, M. Kostka, A. Hadj-Azzem, D. Dufeu, P. Singh, D. Bourgault, M. Nuñez Regueiro, J. Vogel, J. Renard, L. Marty, F. Fabre, A. Finco, V. Jacques, L. Ren, V. Tiwari, C. Robert, X. Marie, N. Bendiab, N. Rougemaille, and J. Coraux, Stability of the in-plane room temperature van der Waals ferromagnet chromium ditelluride and its conversion to chromium-interleaved $CrTe_2$ compounds, ACS Appl. Elec. Mater. **5**, 764 (2023).