Magnetism and phase formation in the candidate dilute magnetic semiconductor system $\text{In}_{2-x}\text{Cr}_x\text{O}_3$: bulk materials are dilute paramagnets

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Supporting Information
Figure S1. (a) Polyhedral representation of the crystal structure of $\text{In}_{1.95}\text{Cr}_{0.05}\text{O}_3$
(b) local coordination around the two symmetry-dependent octahedral sites ($8b$ In/Cr1 and $24d$ In/Cr2). Different colours represent symmetry-inequivalent Cr-O bonds. (c)
ORTEP representation (90% probability ellipsoids) of the structure of phase 1 (majority phase) of $\text{In}_{1.85}\text{Cr}_{0.15}\text{O}_3$ refined from neutron powder diffraction data at room temperature. In/Cr centres are represented in black.

(b) Fig. S2(a) Magnetization curves as a function of the applied field at room temperature for $\text{In}_{1.96}\text{Cr}_{0.04}\text{O}_3$, $\text{In}_{1.95}\text{Cr}_{0.05}\text{O}_3$, $\text{In}_{1.9}\text{Cr}_{0.1}\text{O}_3$ and $\text{In}_{1.85}\text{Cr}_{0.15}\text{O}_3$ and $\text{In}_2\text{O}_3$. $M$ is expressed in e.m.u. per mol material.
(b) Saturation magnetisation (Mₘ in µ_B/Cr) in In₂₋ₓCrₓO₃ versus x (data are shown for x = 0.05 for different preparation methods and thermal treatments) in e.m.u./mol material.

![Figure S3](image_url)

Figure S3. Magnetization (M) in µ_B per Cr atom as a function of applied field (H) at T = 300K and 350K for In₁.₉₅Cr₀.₀₅O₃.

![Figure S4](image_url)

Figure S4. Magnetization (M) isotherm expressed in µ_B per atom for Cr₂O₃ and In₂O₃ at room temperature.
Figure S5. Dependence of magnetization (M) per Cr atom on applied field (H) at room temperature for x = 0.05, as prepared (black points) and annealed under three different reducing atmospheres.

Figure S6. Magnetization (M) expressed in $\mu_B$ per Cr atom function of applied field (H) for $\text{In}_{1.95}\text{Cr}_{0.05}\text{O}_3$ (sample B and C).
Figure S7. Magnetic susceptibility (derived by subtraction of 5T and 2T datasets) versus temperature of In$_{1.95}$Cr$_{0.05}$O$_3$ (sample C). The solid line shows the fit to the simple modified Curie-Weiss law given in the text.

Table S1. Cell parameters values of In-doped Cr$_2$O$_3$ as a secondary phase obtained from refinement of XRPD data for In$_{2-x}$Cr$_x$O$_3$ (x = 0.15, 0.2 and 0.25)

<table>
<thead>
<tr>
<th></th>
<th>x = 0.15</th>
<th>x = 0.2</th>
<th>x = 0.25</th>
<th>Cr$_2$O$_3$</th>
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</thead>
<tbody>
<tr>
<td>a / Å</td>
<td>4.9675522(10)</td>
<td>4.9664469(7)</td>
<td>4.9623895(10)</td>
<td>4.9570</td>
</tr>
<tr>
<td>c / Å</td>
<td>13.5967703(2)</td>
<td>13.59500690(13)</td>
<td>13.57928750(17)</td>
<td>13.5923</td>
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<tr>
<td>V / Å$^3$</td>
<td>290.57(7)</td>
<td>290.40(4)</td>
<td>289.59(6)</td>
<td>289.242</td>
</tr>
</tbody>
</table>

- after Rietveld refinement the fractions (wt) of phases are:

x = 0.15: 93.68% bixbyite and 6.32% Cr$_2$O$_3$, for x = 0.2: 88.23% bixbyite and 11.77% Cr$_2$O$_3$, for x = 0.25: 82.81% bixbyite and 17.19% Cr$_2$O$_3$