

# Transition Elements Overview

ChatGPT said:



## Standard Electrode Potentials for $M^{2+}/M$ and $M^{3+}/M^{2+}$ in Transition Metals:

### 1. $M^{2+}/M$ Series:

For the first-row transition metals, the standard electrode potentials  $E^0$  (in volts) for the reduction of  $M^{2+}$  to  $M$  are as follows:

- **Titanium (Ti):**  $E^0 = -1.63 V$
- **Vanadium (V):**  $E^0 = -1.18 V$
- **Chromium (Cr):**  $E^0 = -0.90 V$
- **Manganese (Mn):**  $E^0 = -1.18 V$
- **Iron (Fe):**  $E^0 = -0.44 V$
- **Cobalt (Co):**  $E^0 = -0.28 V$
- **Nickel (Ni):**  $E^0 = -0.25 V$
- **Copper (Cu):**  $E^0 = +0.34 V$
- **Zinc (Zn):**  $E^0 = -0.76 V$

This trend shows that, in general, the values become less negative as we move from left to right across the period. This indicates decreasing reducing power across the series.

### 2. $M^{3+}/M^{2+}$ Series:

For the reduction of  $M^{3+}$  to  $M^{2+}$ , the standard electrode potentials  $E^0$  (in volts) are as follows:

- **Titanium (Ti):**  $E^0 = -0.37 V$
- **Vanadium (V):**  $E^0 = -0.26 V$
- **Chromium (Cr):**  $E^0 = -0.41 V$
- **Manganese (Mn):**  $E^0 = +1.51 V$
- **Iron (Fe):**  $E^0 = +0.77 V$
- **Cobalt (Co):**  $E^0 = +1.81 V$

Notably, the higher positive values for manganese and cobalt indicate that  $Mn^{2+}$  and  $Co^{2+}$  are much more stable compared to their  $M^{3+}$  states.

### Observations:

- **Reduction Potentials:** More positive values indicate a higher tendency for reduction, meaning the metal is less likely to lose electrons and is a weaker reducing agent.

- **Stability of Ions:** The stability of  $M^{2+}$  ions, such as  $Mn^{2+}$  (with a half-filled  $d^5$  configuration) and  $Zn^{2+}$  (with a fully filled  $d^{10}$  configuration), plays a significant role in their relatively lower reduction potentials.