

On phase diagrams of Sodium and Lithium

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Pressure causes extraordinary changes in the properties of matter by bringing the atoms closer and closer to each other. It can turn the air we breathe into beautiful dark red oxygen crystal and make a semiconducting polymer out of nitrogen. Indeed most matter exists under extreme conditions, so it is clear that we can fully understand the natural world only with knowledge of the fundamental physical and chemical forces at play at high pressures. I will show what extreme conditions of pressure and temperature affect the behaviour of the simplest metals: sodium and lithium. Because of their simplicity, light alkali metals have long been used as a paradigm in fundamental sciences, but we show that extreme conditions cause dramatic changes in their very well properties. The two elements exhibit peculiar melting curves with a pronounced minimum at high pressures: sodium melts at 300 K and ~118 GPa while the minimum of the lithium melting curve is at 190 K at 50 GPa, the lowest melting temperature known at these pressures. Using single-crystal high-pressure diffraction techniques we show that both elements adopt novel very complex crystal modifications under pressure.