COLD SINTERING OF CERAMIC MATERIALS

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ABSTRACT
Sintering ceramics usually needs a temperature of over 1000°C. To reduce the quantity of heat generated, a novel sintering process has been devised. It may sinter oxides, carbonates, bromides, fluorides, chlorides, and phosphates.

INTRODUCTION
Oxides and ceramics are frequently sintered by firing them at high temperatures — this is known as conventional sintering. These approaches are hampered by the problem of physical and chemical incompatibility at high temperatures.

The significant benefit of cold sintering is the reduction in temperature and the speeding of the diffusion process through the use of pressure. As a result, many inorganic materials and ceramic-based composites may now be manufactured at far lower temperatures than previously thought possible.

METHODS AND MATERIALS
Cold sintering was used to create dense ceramics of Li2MoO4, Na2Mo2O7, K2Mo7, and V2O5, as well as dense composites of 0.8Li2Mo4-0.2BaFe12O19, 0.5PTFE, 0.5Li2 MoM3-0.6LiM3, and 0.9LiM2O4-1.2EG.

The solid state reaction technique is an important step in the creation of all of the compounds below.

Method one: All dry powders were stored in a constant relative humidity environment for 10-360 minutes.

Method two: The wet pellets were heated pressed with a steel die into dense pellets at 80-570 MPa and 120 °C then dried in an oven for 6-12 hours.

SIGNIFICANT RESULTS
Microstructures that are more than 90% dense in the room temperature range.

After cold sintering, there are no visible impurities or second phases.

This experiment shows how to effectively employ pressure to increase the driving power of a thermoelectric device.

CONCLUSIONS
Cold sintering has advantages over traditional sintering processes. After sintering, the materials have a high purity and density.

A significantly reduced thermal budget reduces energy use.

The benefits of organic and organic integration with the ideal combination.

REFERENCES

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TABLE 1. The relative density of the Cold Sintered Samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Relative density</th>
<th>Pressure</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>K2Mo7O7</td>
<td>95.7%</td>
<td>350 MPa</td>
<td>120 °C</td>
</tr>
<tr>
<td>Na2Mo2O7</td>
<td>95.7%</td>
<td>350 MPa</td>
<td>120 °C</td>
</tr>
<tr>
<td>Li2Mo2O7</td>
<td>94.1%</td>
<td>350 MPa</td>
<td>120 °C</td>
</tr>
<tr>
<td>V4O9</td>
<td>90.2%</td>
<td>350 MPa</td>
<td>120 °C</td>
</tr>
</tbody>
</table>

Figure 3: The left picture show the NaCl cold sintered sample and the right the conventional sintered sample.

Figure 4: highlights the cold sintered sample of K2Mo7O7 as a function of pressure, temperature, and time.