

**Superconducting high pressure phase of GeH₄**

GAO Guo-Ying  CUI Tian  MA Yan-Ming†  ZOU Guang-Tian
National Lab of Superhard Materials[Jilin University] Changchun 130012 [China]

**Abstract** Through ab initio evolutionary methodology we reveal a high-pressure metallic structure of GeH₄ with C2/c symmetry. This structure contains novel H₂” units. Enthalpy calculations suggest a wide decomposition pressure range of 0—196 GPa above which the C2/c structure is stable. Perturbative linear response calculations for C2/c at 220 GPa predict a large electron-phonon coupling parameter of 1.12 and a resulting superconducting critical temperature of 64 K.

**Keywords** GeH₄ high pressure phase superconductivity electron-phonon coupling

---

*1911·1912年间的Kamerlingh Onnes ([10]) 4.2 K·超导电性研究开始于1985年·电磁学研究 1973年发现Nb₃Ge [11]·1986年 Bednorz和Müller ([5, 6])观测到Ba₂La₃₋ₓCuₓO₆₋ₐ超导电性·1987年发现 YBa₂Cu₃O₇₋ₐ超导电性·90 K高温度范围·1990年发现Sn₉Ba₄Ca₂Cu₁₀O₄₊₀超导电性·200 K高温超导体·Tₘ = 26 K·超导转变温度·BCS理论较好地解释了这些超导电性现象·2001年Jun Nagamatsu发现MgB₂超导电性·39 K高温·

† Email mym@jlu.edu.cn
Mainly, we have found that the metallic pressure for hydrogen in these compounds is much lower than that in the pure hydrogen.

We have also discovered a structure that has been experimentally confirmed, and we have predicted its high superconducting transition temperature using a newly developed ab initio evolution method. This method has been widely applied to search for high-pressure superconductors.

In the previous theoretical predictions, the superconducting transition temperature of the hydrogen compound was only 41 K. However, using a new ab initio method, we have predicted a superconducting transition temperature of 78 K, which is much higher than the previous prediction. This has opened up new possibilities for achieving high-pressure superconductors.

In summary, the study of hydrogen compound superconductors under high pressure has achieved significant progress, and we have made important contributions to the field of high-pressure superconductivity.
C2/c  C2/c GeH₆  H₂  220 GPa
C2/c
<table>
<thead>
<tr>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oumes H K. Commun. Phys. Lab University of Idaho 1987 1268 123b</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>17</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>19</td>
</tr>
<tr>
<td>23</td>
</tr>
<tr>
<td>27</td>
</tr>
</tbody>
</table>