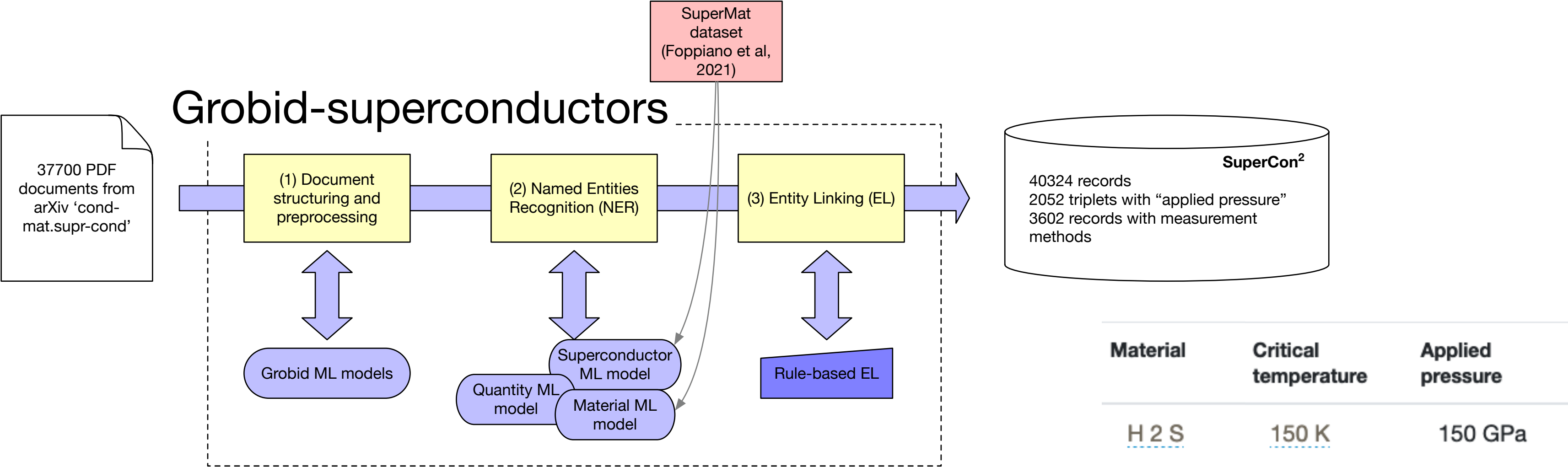


Grobid-superconductors



Example

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(1) **Title** **Abstract** **Body**

From LaH₁₀ to room-temperature superconductors

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Thermodynamic parameters of the LaH₁₀ superconductor were an object of our interest. LaH₁₀ is characterised by the highest experimentally observed value of the critical temperature: $T_C^0 = 215$ K ($p_0 = 150$ GPa) and $T_C^0 = 260$ K ($p_0 = 190$ GPa). It belongs to the group of superconductors with a strong electron-phonon coupling ($\lambda_e \sim 2.2$ and $\lambda_s \sim 2.8$). We calculated the thermodynamic parameters of this superconductor and found that the values of the order parameter, the thermodynamic critical field, and the specific heat differ significantly from the values predicted by the conventional BCS theory. Due to the specific structure of the Eliashberg function for the hydrogenated compounds, the qualitative analysis suggests that the superconductors of the LaX₁₀-H₁₀-type (LaXH-type) structure, where X ∈ {Sc, Y, La} would exhibit significantly higher critical temperature than T_C obtained for LaH₁₀. In the case of LaScH we came to the following assessments: $T_C^0 \in (220, 267)$ K and $T_C^0 \in (263, 294)$ K, while the results for LaYH were: $T_C^0 \in (218, 247)$ K and $T_C^0 \in (261, 274)$ K.

The experimental discovery of the high-temperature superconducting state in the compressed hydrogen and sulfur systems H₂S ($T_C = 150$ K for $p = 150$ GPa) and H₃S ($T_C = 203$ K for $p = 150$ GPa)^{1,2} accounts for carrying out investigations, which can potentially lead to the discovery of a material showing the superconducting properties at room temperature. For the first time, the possibility of the existence of the superconducting state in hydrogenated compounds is induced by the conventional electron-phonon interaction. This fact made possible the theoretical description of the superconducting phase in H₂S and H₃S even prior to carrying out the suitable experiments^{1,2}. The detailed discussions with respect to the thermodynamic properties of the superconducting state occurring in H₂S and H₃S one can find in references¹⁻¹².

In 2018, there were held the groundbreaking experiments, which confirmed the existence of the superconducting state of extremely high values of the critical temperature in the LaH₁₀ compound: $T_C^0 = 215$ K for $p_0 = 150$ GPa and $T_C^0 = 260$ K for $p_0 \in (180-200)$ GPa (and then $T_C^0 = 250$ K for $p_0 = 170$ GPa¹³). It was proved on the theoretical basis¹⁴ that the results achieved by Drozdov *et al.*¹⁵ can be related to the induction of the superconducting phase in the R $\bar{3}m$ structure ($T_C = 206-223$ K). The experimental results reported by Somayazulu *et al.*¹⁶ should be related to the superconducting state induced in the Fm $\bar{3}m$ structure, where the critical temperature can potentially reach even the value of 280 K. From the materials science perspective, the achieved results imply that all possible actions should be taken in order to examine the hydrogen-containing materials with respect to the existence of the high-temperature superconducting state at room temperature. Attention should be paid to the importance of the discovery of the high-temperature superconducting state in LaH₁₀ because La can form stable hydrogenated compounds with other metals. Such materials can exhibit so large hydrogen concentration, that they are presently taken into account as basic components of the hydrogen cells intended for vehicle drives¹⁷.

The purpose of this work is, firstly, to present the performed analysis of the thermodynamic properties of the superconducting state in the LaH₁₀ compound. We took advantage of the phenomenological version of the Eliashberg equations, for which we fitted the value of the electron-phonon coupling constant on the basis of the experimentally found T_C value. Our next step consisted in examining the hydrogenated compounds of the LaX₁₀-H₁₀-type (LaXH-type) on the basis of the achieved results in order to find a system with an even higher value of the critical temperature. Taking into account the structure of the Eliashberg function for hydrogenated

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(2)

Material

Tc expression

Pressure

Temperature

(3)

Linking

Linking

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