**Socratic Method Evaluation Form**

In this paper, we apply the Mixed Socratic Prompting Approach to a range of problems in chemistry and materials science, developing a structured methodology to enhance LLM reasoning through Socratic inquiry. This framework is designed to evaluate the performance of the Socratic Prompting Approach by comparing it with regular LLM reasoning. It is structured to help you track and assess LLM performance across different approaches. Please complete the provided sections accordingly.

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Field: Crystal Growth and Radiation Detectors

Are you the expert on the field of question? Yes No

Does this prompt directly relate with your active research area? Yes No

1. Go to **ARGO** and select **Custom Task Type.**
2. **Write your prompt in a conventional, direct-answer manner.**

Prompt:

I want to calculate the oxidation rate of lead and bismuth thin films. Assume that oxidation occurs at 25 °C, 0% humidity, and under ambient conditions. How can the oxidation rate be calculated, and what is the required time to oxidize a 500 nm thin film?

Add follow up prompts below:

Follow-up 1:

I added reference for oxidation rate of Pb thin film. Can you extract rate constant and make calculations according to provided conditions in the previous prompt? (reference article can be found in the folder).

Follow-up 2:

Click or tap here to enter text.

Follow-up 3:

Click or tap here to enter text.

Do you have more follow-up prompts? Yes No

What is the exported file name? Traditional LLM - Oxidation of Metal Thin Films.txt

1. **Evaluate the performance of conventional approach.**

|  |  |
| --- | --- |
| Clarity | 4 |
| Depth of reasoning | 3 |
| Hypothesis refinement | 3 |
| Novelty of insights | 2 |
| Consistency | 4 |
| Applicability to real problems | 3 |
| Logical Coherence | 4 |
| Correctness of conclusions | 2 |
| Self-correction & iteration | 4 |
| Overall effectiveness | 4 |

1. **Enter observations and comments about conventional approach.**

Mentioned in the assessment document.

1. Start a new chat on ARGO, and switch to Socratic prompting. Develop a reasoning flow for your problem. Refer the page 17*,* ***Socratic Questioning & Chain-of-Thought Prompting*** section in the paper. Use **Figure 2 & Tables 3 & 4** to select Socratic principles.
2. Did you used same prompt at the beginning? Yes No
3. Did you use same follow up prompts? Yes No

If your answer is no, please fill the boxes below.

Follow-up 1:

How do we define the parabolic rate law for oxidation, and what assumptions underlie its application to lead and bismuth thin films?

Follow-up 2:

If the oxidation rate deviates from the expected parabolic behavior, what alternative mechanisms could explain the observed kinetics, and how might these affect the estimated time for complete oxidation?

Follow-up 3:

I provided you a reference article for Pb oxidation. Can you examine this article and answer the questions again? (reference article is given in the folder)

Do you have more follow-up prompts? Yes No

What is the exported file name? Socratic LLM - Oxidation of Metal Thin Films.txt

1. **Evaluate the performance of Socratic Prompting approach.**

|  |  |
| --- | --- |
| Clarity | 4 |
| Depth of reasoning | 3 |
| Hypothesis refinement | 2 |
| Novelty of insights | 2 |
| Consistency | 2 |
| Applicability to real problems | 2 |
| Logical Coherence | 3 |
| Correctness of conclusions | 2 |
| Self-correction & iteration | 2 |
| Overall effectiveness | 2 |

1. **Enter observations and comments about Socratic Prompting approach.**

Mentioned in the assessment document.

1. **Analysis of results from an expert point of view.**

Mentioned in the assessment document.

1. **Evaluate the performance of Socratic and non-Socratic responses. Which one provides accurate and reliable responses? Why?**

Mentioned in the assessment document.

1. **What are the limitations and possible improvements?**

Mentioned in the assessment document.