论文选题灵感：“ 制氢技术 ”研究方向丨MDPI Gases

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随着全球能源结构的不断转型与可持续发展的不断推进，氢能作为一种清洁、高效的能源载体，受到越来越多的关注。氢气具有高能量密度、零排放等优点，被广泛认为是未来能源体系中的关键组成部分。在多种能源转换与存储技术中，制氢技术居于基础地位，是实现氢能广泛应用的前提与基础。当前，传统的制氢方法主要依赖化石燃料，如天然气重整，但其伴随的碳排放问题引发了对绿色、低碳制氢技术的迫切需求。近年来，水电解、光催化以及新兴的化学催化等绿色制氢技术不断取得突破，为低能耗、环保的氢气生产提供了新的解决方案。因此，深入研究与优化制氢技术，推动其工业化应用，对于实现能源结构转型、改善环境生态具有重要意义。

1. The Hydrogen Color Spectrum: Techno-Economic Analysis of the Available Technologies for Hydrogen Production

氢的颜色谱系：现有制氢技术的技术经济分析

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Review

The Hydrogen Color Spectrum: Techno-Economic Analysis of the Available Technologies for Hydrogen Production

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Abstract: Hydrogen has become the most promising energy carrier for the future. The spotlight is now on green hydrogen, produced with water electrolysis powered exclusively by renewable energy sources. However, several other technologies and sources are available or under development to satisfy the current and future hydrogen demand. In fact, hydrogen production involves different resources and energy loads, depending on the production method used. Therefore, the industry has tried to set a classification code for this energy carrier. This is done by using colors that reflect the hydrogen production method, the resources consumed to produce the required energy, and the number of emissions generated during the process. Depending on the reviewed literature, some colors have slightly different definitions, thus making the classifications imprecise. Therefore, this techno-economic analysis clarifies the meaning of each hydrogen color by systematically reviewing their production methods, consumed energy sources, and generated emissions. Then, an economic assessment compares the costs of the various hydrogen colors and examines the most feasible ones and their potential evolution. The scientific community and industry's clear understanding of the advantages and drawbacks of each element of the hydrogen color spectrum is an essential step toward reaching a sustainable hydrogen economy.

Keywords: hydrogen production technologies; hydrogen colors; techno-economic analysis

Citation: Arcos, J.M.M.; Santos,

本文综述分析了不同类型颜色的氢，旨在对其进行技术与经济层面的对比，并明确这些技术在当前的可行性。

选题灵感

所有这些氢源都有进一步开发的空间，有望通过扩大产量成为未来的主要能源载体。遗憾的是，所有排放大量温室气体的技术都必须逐步淘汰—尽管这些技术目前成熟度最高、成本也最低。因此，低碳制氢方法必须不断发展和改进，以实现低成本且无二氧化碳排放的目标。

2. Hydrogen Purification through a Membrane – Cryogenic Integrated Process: A 3 E ’ s (Energy, Exergy, and Economic) Assessment

通过膜 – 低温集成工艺提纯氢气：3E（能量、火用与经济性）评估

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Article

Hydrogen Purification through a Membrane–Cryogenic Integrated Process: A 3 E's (Energy, Exergy, and Economic) Assessment

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Abstract: Hydrogen (H_2) is known for its clean energy characteristics. Its separation and purification to produce high-purity H_2 is becoming essential to promoting a H_2 economy. There are several technologies, such as pressure swing adsorption, membrane, and cryogenic, which can be adopted to produce high-purity H_2; however, each standalone technology has its own pros and cons. Unlike standalone technology, the integration of technologies has shown significant potential for achieving high purity with a high recovery. In this study, a membrane–cryogenic process was integrated to separate H_2 via the desublimation of carbon dioxide. The proposed process was designed, simulated, and optimized in Aspen Hysys. The results showed that the H_2 was separated with a 99.99% purity. The energy analysis revealed a net-specific energy consumption of 2.37 kWh/kg. The exergy analysis showed that the membranes and multi-stream heat exchangers were major contributors to the exergy destruction. Furthermore, the calculated total capital investment of the proposed process was 816.2 m$. This proposed process could be beneficial for the development of a H_2 economy.

Keywords: membrane separation; process simulation; CO_2 solidification; H_2 liquefaction; cryogenic separation; integrated process

Citation: Naquash, A.; Riaz, A.; Yehia, F.; Chaniago, Y.D.; Lim, H.; Lee, M. Hydrogen Purification through a Membrane–Cryogenic

本研究将重点放在氢气的分离和净化上，通过膜技术和低温（升华）技术相结合，以生产高纯度且回收率高的氢气。

选题灵感

随着人们对氢能经济的关注度日益提高，高纯度氢气的生产正变得至关重要。高纯度氢气被应用于诸多领域，例如氢燃料电池和液氢生产。如何以高回收率和低能耗生产高纯度氢气，是一个具有挑战性的问题。本文提出的膜 – 低温集成工艺可生产出纯度为 99.99%、回收率为 95.9% 的氢气，其净比能耗（SEC）为 2.37 千瓦时 / 千克。这种集成工艺有望为推动氢能经济发展带来优势。未来关于该工艺的研究工作可包括基于高级火用分析的详细评估。

3. Theoretical Analysis and Modelling of LNG Reforming to Hydrogen Marine Fuel for FLNG Applications

浮式液化天然气（FLNG）应用中液化天然气重整制船用氢燃料的理论分析与建模

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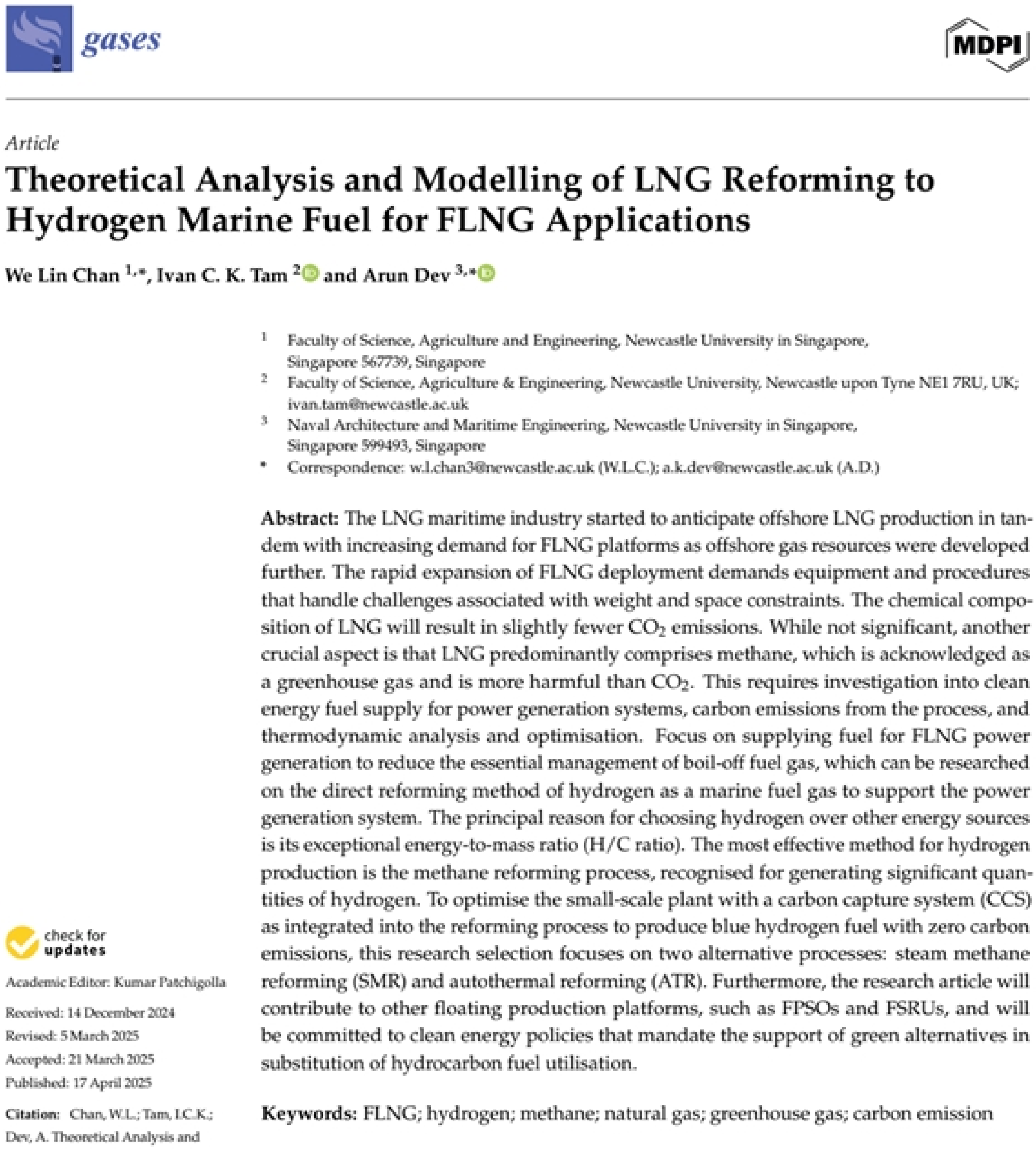
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Article

Theoretical Analysis and Modelling of LNG Reforming to Hydrogen Marine Fuel for FLNG Applications

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Abstract: The LNG maritime industry started to anticipate offshore LNG production in tandem with increasing demand for FLNG platforms as offshore gas resources were developed further. The rapid expansion of FLNG deployment demands equipment and procedures that handle challenges associated with weight and space constraints. The chemical composition of LNG will result in slightly fewer CO_2 emissions. While not significant, another crucial aspect is that LNG predominantly comprises methane, which is acknowledged as a greenhouse gas and is more harmful than CO_2. This requires investigation into clean energy fuel supply for power generation systems, carbon emissions from the process, and thermodynamic analysis and optimisation. Focus on supplying fuel for FLNG power generation to reduce the essential management of boil-off fuel gas, which can be researched on the direct reforming method of hydrogen as a marine fuel gas to support the power generation system. The principal reason for choosing hydrogen over other energy sources is its exceptional energy-to-mass ratio (H/C ratio). The most effective method for hydrogen production is the methane reforming process, recognised for generating significant quantities of hydrogen. To optimise the small-scale plant with a carbon capture system (CCS) as integrated into the reforming process to produce blue hydrogen fuel with zero carbon emissions, this research selection focuses on two alternative processes: steam methane reforming (SMR) and autothermal reforming (ATR). Furthermore, the research article will contribute to other floating production platforms, such as FPSOs and FSRUs, and will be committed to clean energy policies that mandate the support of green alternatives in substitution of hydrocarbon fuel utilisation.

Keywords: FLNG; hydrogen; methane; natural gas; greenhouse gas; carbon emission

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本研究的主要目标是探究蓝氢燃料作为重整工艺中传统燃料替代品的能源潜力，重点关注浮式平台的能源需求。

选题灵感

关于海上 FLNG 平台未来的制氢研究，考虑采用蒸汽甲烷重整（SMR）和自热重整（ATR）相结合的混合技术，有望实现成本和能耗的降低。将其与可再生电力整合（例如电解 + ATR），则可能进一步提升可持续性。在征收碳税的环境下，碳捕集技术的改进将决定 SMR 是否仍能与 ATR 保持竞争力。

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