

December 1 - Lawyer's Day

(first Sunday of December).

All who serve the law, truth and justice accept congratulations. On the first Sunday of December, Belarusian lawyers celebrate their holiday regardless of their professional field - lawyers and prosecutors, investigators and notaries, judges and legal advisers. These people have a mission to build a legal culture and respect for the law.

December 3 - Day of invalids in Belarus.

On this day, it will not be superfluous to remind everyone that among us there live people who deserve not only sympathy, but above all help, ensuring their rights to a decent life, work and rest.

December 7 - Day of Insurance Workers (first Saturday of December).

Taking into account the role of insurance organizations in the state economy, in 1998 it was decided to establish this professional day. The date of the holiday was not chosen by chance. It was on the first Saturday of December that the above Decree of the Council of People's Commissars was ratified. This date is considered the day of formation of Belgosstrakh.



Гомельский государственный
университет
имени Франциска Скорины
студенческая газета
кафедры английского языка
№ 8 December 2019

THE WORLD

Belarusian holidays



New discoveries

in

biology & chemistry



December 20 - Day of the employee of state security agencies.

In modern conditions, along with the traditional functions of intelligence and counterintelligence, the republic's state security bodies are at the forefront of the fight against such socially dangerous phenomena as terrorism, organized and economic crime, corruption, and the drug business.

December 22 - Power Engineer Day.

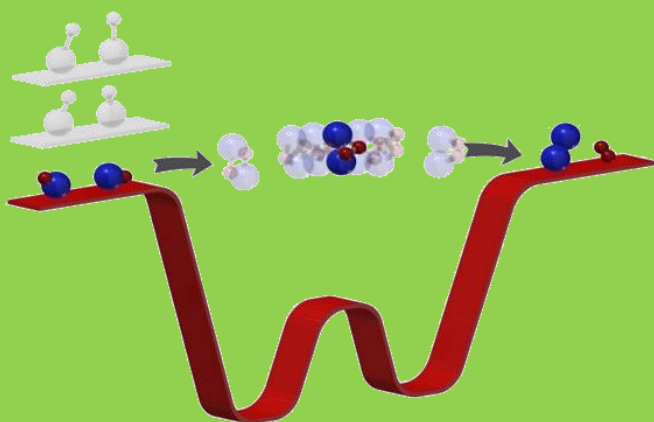
This is a professional holiday for all industrial workers, covering the generation, transmission and marketing of electricity and heat to consumers.

December 25 - Catholic Christmas.

One of the most important Christian holidays and a national holiday in more than 100 countries of the world.



Direct observation of bimolecular reactions
of ultracold
KRb molecules



Femtochemistry techniques have been instrumental in accessing the short time scales necessary to probe transient intermediates in chemical reactions. In this

study, we took the contrasting approach of prolonging the lifetime of an intermediate by preparing reactant molecules in their lowest rovibronic quantum state at ultralow temperatures, thereby markedly reducing the number of exit channels accessible upon their mutual collision. Using ionization spectroscopy and velocity-map imaging of a trapped gas of potassium-rubidium (KRb) molecules at a temperature of 500 nanokelvin, we directly observed reactants, intermediates, and products of the reaction

$$^{40}\text{K}^{87}\text{Rb} + ^{40}\text{K}^{87}\text{Rb} \rightarrow \text{K}_2\text{Rb}_2^* \rightarrow \text{K}_2 + \text{Rb}_2.$$

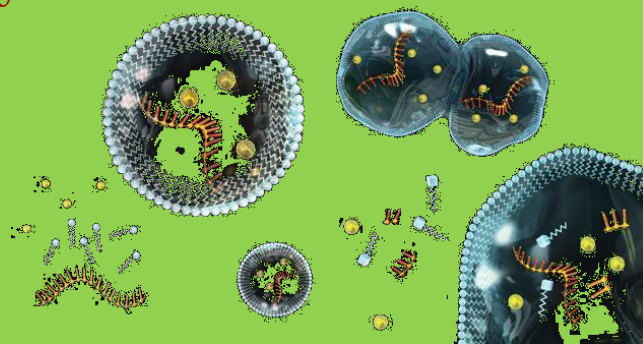
Beyond observation of a long-lived, energy-rich intermediate complex, this technique opens the door to further studies of quantum-state-resolved reaction dynamics in the ultracold regime.



The role of sugar-backbone heterogeneity
and chimeras in the simultaneous emergence

of RNA and

DNA



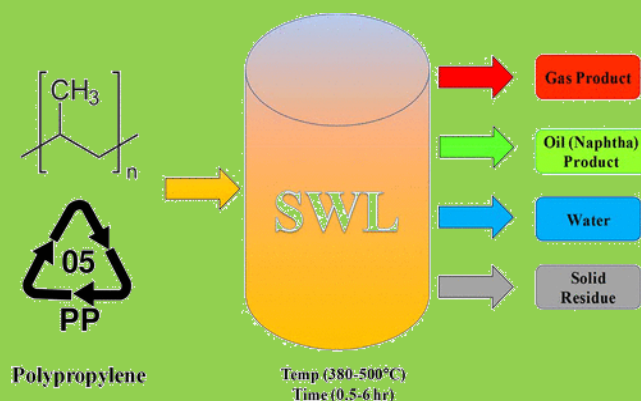
Hypotheses of the origins of RNA and DNA are generally centred on the prebiotic synthesis of a pristine system (pre-RNA or RNA), which gives rise to its descendent. However, a lack of specificity in the synthesis of genetic polymers would probably result in chimeric sequences; the roles and fate of such sequences are unknown. Here, we show that chimeras, exemplified by mixed threose nucleic acid (TNA)–RNA and RNA–DNA oligonucleotides, preferentially bind to, and act as templates for, homogeneous TNA, RNA and DNA ligands. The chimeric templates can act as a catalyst that mediates the ligation of oligomers to give homogeneous backbone sequences, and the regeneration of the chimeric templates potentiates a scenario for a possible cross-catalytic cycle with amplification. This process provides a proof-of-principle demonstration of a heterogeneity-to-homogeneity scenario and also gives credence to the idea that DNA could appear concurrently with RNA, instead of being its later descendent.



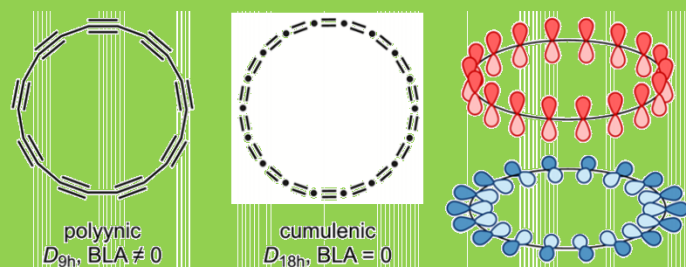
Use of Supercritical Water for the Liquefaction of Polypropylene into Oil

About five billion tons of plastic waste have accumulated in landfills and the natural environment over the past 50 years. Polypropylene (PP) waste accounts for about 23% of the total plastic waste. Converting PP waste into useful products can reduce the accumulated waste and associated risks to the environment and human health. In this study, model PP was converted into oil using supercritical water at 380–500 °C and 23 MPa over a reaction time of 0.5–6 h. Up to 91 wt % of model PP was converted into oil at 425 °C with a 2–4 h reaction time or at 450 °C with a 0.5–1 h reaction time. Higher reaction temperatures (>450 °C) or longer reaction times (>4 h) led to more gas products. The oil products consisted of olefins, paraffins, cyclics, and aromatics. About 80–90 wt % of the oil components had the same boiling point range as naphtha (25–200 °C) and heating values of 48–49 MJ/kg. Reaction pathways for converting model PP into oil under the tested conditions were proposed. Preliminary analyses indicate that this conversion process is net-energy positive and potentially has a higher energy efficiency and lower greenhouse gas emissions than incineration and mechanical recycling. The oil derived from PP has the potential to be

used as gasoline blendstocks or feedstocks for other chemicals.



An sp²-hybridized molecular carbon allotrope, cyclo[18]carbon



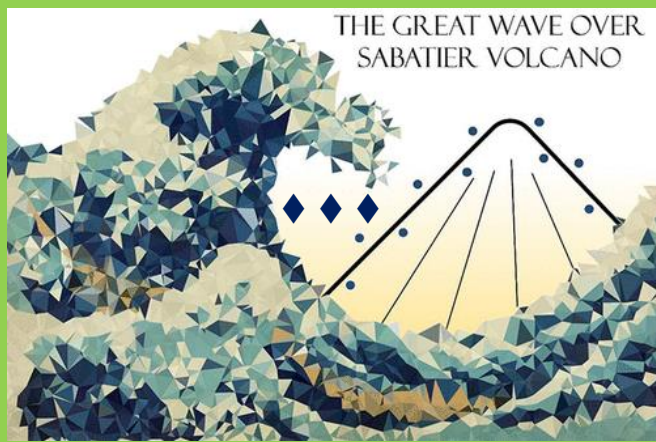
Carbon allotropes built from rings of two-coordinate atoms, known as cyclo[n]carbons, have fascinated chemists for many years, but until now they could not be isolated or structurally characterized because of their high reactivity. We generated cyclo[18]carbon (C₁₈) using atom manipu-

lation on bilayer NaCl on Cu(111) at 5 kelvin by eliminating carbon monoxide from a cyclocarbon oxide molecule, C₂₄O₆. Characterization of cyclo[18]carbon by high-resolution atomic force microscopy revealed a polyynic structure with defined positions of alternating triple and single bonds. The high reactivity of cyclocarbon and cyclocarbon oxides allows covalent coupling between molecules to be induced by atom manipulation, opening an avenue for the synthesis of other carbon allotropes and carbon-rich materials from the coalescence of cyclocarbon molecules.

Principles of Dynamic Heterogeneous Catalysis: Surface Resonance and Turnover Frequency Response

Acceleration of the catalytic transformation of molecules via heterogeneous materials occurs through design of active binding sites to optimally balance the requirements of all steps in a catalytic cycle. In accordance with the Sabatier principle, the characteristics of a single binding site are balanced between at least two transient phenomena, leading to maximum possible catalytic activity at a single, static condition (i.e., a “volcano curve” peak). In this

work, a dynamic heterogeneous catalyst oscillating between two electronic states was evaluated via simulation, predicting catalytic activity as much as three-to-four orders of magnitude (1000–10 000) above the Sabatier maximum. Surface substrate binding energies were varied by a given amplitude ($0.1 < \Delta U < 3.0$ eV) over a broad range of frequencies ($10^{-4} < f < 10^{11}$ s⁻¹) in square, sinusoidal, sawtooth, and triangular waveforms to characterize surface dynamics impact on average catalytic turn-over frequency. Catalytic systems were shown to exhibit order-of-magnitude dynamic rate enhancement at “surface resonance” defined as the band of frequencies (e.g., 10^3 – 10^7 s⁻¹) where the applied surface waveform kinetics were comparable to kinetics of individual microkinetic chemical reaction steps. Key dynamic performance parameters are discussed regarding industrial catalytic chemistries and implementation in physical dynamic systems operating above kilohertz frequencies.



Mammalian Near-Infrared Image Vision through Injectable and Self-Powered Retinal Nanoantennae

Highlights

We designed ocular injectable photoreceptor-binding upconversion nanoparticles.

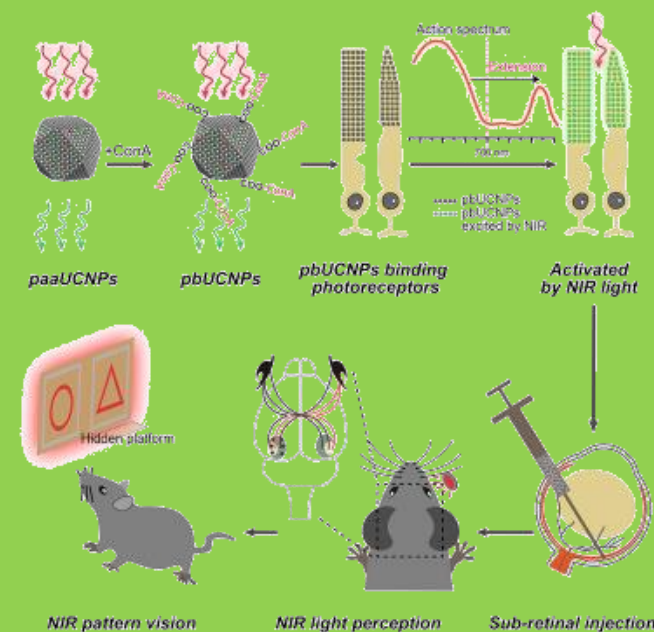
The nanoparticles are safe and enable NIR light sensation and pattern vision.

This NIR pattern vision is compatible with native daylight vision.

This method offers options for mammalian vision repair and enhancement.

Mammals cannot see light over 700 nm in wavelength. This limitation is due to the physical thermodynamic properties of the photon-detecting opsins. However, the detection of naturally invisible near-infrared (NIR) light is a desirable ability. To break this limitation, we developed ocular injectable photoreceptor-binding upconversion nanoparticles (pbUCNPs). These nanoparticles anchored on retinal photoreceptors as miniature NIR light transducers to create NIR light image vision with negligible side effects. Based on single-photoreceptor recordings, electroretinograms, cortical recordings, and visual

behavioral tests, we demonstrated that mice with these nanoantennae could not only perceive NIR light, but also see NIR light patterns. Excitingly, the injected mice were also able to differentiate sophisticated NIR shape patterns. Moreover, the NIR light pattern vision was ambient-daylight compatible and existed in parallel with native daylight vision. This new method will provide unmatched opportunities for a wide variety of emerging bio-integrated nanodevice designs and applications.



*The World, студенческая газета кафедры ан-
глийского языка ГГУ им. Ф. Скорины, № 8 (де-
кабрь), 2019. Редакция: студенты группы
БИ-12а. Корректор: В.Ю. Соболевич*