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ORIGINAL PAPER

Nutrient limitations to bacterial and fungal growth during cellulose decomposition in tropical forest soils

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Abstract Nutrients constrain the soil carbon cycle in tropical forests, but we lack knowledge on how these constraints vary within the soil microbial community. Here, we used in situ fertilization in a montane tropical forest and in two lowland tropical forests on contrasting soil types to test the principal hypothesis that there are different nutrient constraints to different groups of microorganisms during the decomposition of cellulose. We also tested the hypotheses that decomposers shift from nitrogen to phosphorus constraints from montane to lowland forests, respectively, and are further constrained by potassium and sodium deficiency in the western Amazon. Cellulose and nutrients (nitrogen, phosphorus, potassium, sodium, and combined) were added to soils in situ and microbial cellulose after single nutrient additions was highest following nitrogen addition for fungi, suggesting nitrogen as the primary limiting nutrient for cellulose decomposition. This was observed at all sites, with no clear shift in nutrient constraints to decomposition between lowland and montane sites. We also observed positive respiration and fungal growth responses to sodium and potassium addition at one of the lowland sites. However, when phosphorus was added, and especially when added in combination with other nutrients, bacterial growth was highest, suggesting that bacteria out-compete fungi for nitrogen where phosphorus is abundant. In summary, nitrogen constrains fungal growth and cellulose decomposition in both lowland and montane tropical forest soils, but

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Portable low-cost instrumentation for monitoring Rayleigh scattering from chemical sensors based on metallic nanoparticles

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Glibver Vasquez, Yulán Hernández & Yves Coello

Using a Hg(II) sensor based on the aggregation of gold nanoparticles as a model system, we evaluated the performance of two portable low-cost devices that monitor the wavelength-ratiometric resonance Rayleigh scattering signal of the chemical sensor upon white-LED illumination. The first device uses two optical filter-photodiode combinations to detect scattered light while the second employs a novel ultra-compact (grating-free) spectral sensor. Results show that the response of the Hg(II) sensor monitored with these devices is comparable to that measured using a high-end benchtop scanning spectrofluorometer. The great potential of this new LED-spectral sensor was demonstrated with the quantification of Hg(II) in tap and spring water. Due to the promising results obtained, many reported chemical sensors based on Rayleigh scattering from metallic nanoparticles could take advantage of this compact portable instrumentation for cost-effective field-deployable applications.

In the past few decades, metallic nanoparticles have received much attention due to their optical, electrochemical and catalytic properties, which offer enormous opportunities for applications in various scientific and technical fields[1–3]. In particular, silver (AgNPs) and gold nanoparticles (AuNPs) have been widely employed in the design of chemical sensors for numerous relevant species in the medical, forensic, food safety and environmental fields, including proteins, DNA, toxins, and metallic ions. These chemical sensors offer excellent analytical performance (high sensitivity and selectivity) and rapid analysis times[4–10].

Special attention has been paid to colorimetric chemical sensors based on AgNPs and AuNPs because of their high extinction (absorption plus scattering) cross-sections within their localized surface plasmon resonance (LSPR) band. The LSPR band results from the collective oscillations of conducting electrons and falls in the visible electromagnetic region for spherical AgNPs and AuNPs. The position of the LSPR band is affected by various factors such as the size and the shape of the nanostructures, their aggregation state and the environment where they are dispersed. These features explain why the wavelength or intensity of the LSPR band varies in the presence of different analyte concentrations. Thus, these plasmonic nanosensors can be monitored using simple visible spectrophotometers –or even by the naked eye although with lower limits of detection– circumventing the need for expensive instrumentation and time-consuming analysis required by conventional analytical techniques[4–10].

Although significantly less explored than the colorimetric (extinction) detection scheme, resonance Rayleigh scattering (RRS) from metallic colloids can also be exploited in the design and implementation of chemical sensors[11,12]. RRS refers to the elastic scattering process produced when the frequency of the incident light is near an absorption band[13]. For 15 nm-AuNPs, the RRS intensity is comparable to that of fluorescence for the same optical density[13]. Interestingly, AgNPs display even higher RRS cross-sections as compared to AuNPs[13] and have also been exploited in the design of RRS chemical sensors[14–16] but suffer from rapid degradation which lowers their practical application. Furthermore, the RRS scattering efficiency increases as the nanostructure size grows, a very interesting feature for the detection of aggregation patterns[17]. Due to their high scattering cross-sections, these noble metal nanoparticles have even been used as single-particle scattering nanosensors both *in vitro* and *in vivo*[18,19]. In addition, metallic nanoparticles are extremely photostable as they do not photobleach or blink, unlike fluorophores. Based on these distinct advantages, a number of metallic colloid RRS chemical sensors have been reported for the detection of proteins[20], cancer cells[21], metallic ions[13,22–25] and small molecules[13,14,26].

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Adsorption of N,N-dimethylamine from aqueous solutions by a metal organic framework, MOF – 235

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ABSTRACT
Water-resistant MOF-235 was used to adsorb N,N-dimethylamine (DMA) from aqueous solutions. It was synthesized from terephthalic acid and $FeCl_3.6H_2O$ under air-free conditions and characterized by its crystalline structure, functional groups and temperature resistance. The kinetic data results were best adjusted to the pseudo-second order model (R^2>0.963). The best-fit isotherm, Langmuir model, suggested the adsorption of DMA is localized on homogenously distributed active sites on the surface. This fit was confirmed by the value of $\beta = 1$ on the Redlich-Peterson model. Our study suggests that the manipulation of novel materials such as MOF-235 promises new avenues for water treatment solutions.

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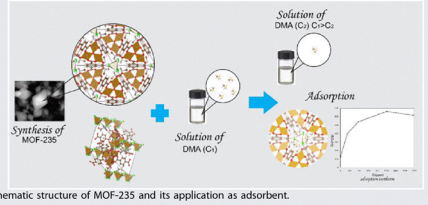
KEYWORDS
MOF-235; adsorption; dimethylamine; MOF; water treatment

GRAPHICAL ABSTRACT



Schematic structure of MOF-235 and its application as adsorbent.

Introduction

DMA is a pollutant produced as a byproduct by chemical and pharmaceutical companies and is a precursor for the carcinogenic compound NDMA (N-nitrosodimethylamine).[1] Common decontamination methods may increase levels of NDMA[2] while effective treatment proves costly and requires sophisticated infrastructure. Thus, novel methods of removal are in demand. Under the pressure to develop methods to eliminate DMA, various strategies have been developed including photocatalytic degradation,[3] mineralization, and adsorption on resins.[4] However, these methods fail to attain a complete removal of DMA.

Adsorption is a promising method because of its low operational cost, easy design and its lack of harmful byproducts.[5] A wide array of microporous materials have been applied as adsorbents such as activated carbon,[6] silicon,[7] TiO_2[8] and zeolites.[9]

The use of metal organic frameworks (MOFs) to adsorb organic compounds and gases has been widely studied. MOFs are porous materials formed by the unification of organic compounds and metal ions into a joint structure.[10] MOF-235 was chosen as a suitable adsorbent of DMA because of its porous structure and large surface area.[11] It is insoluble in water, so it can be used in water treatment applications. Moreover, it has previously been used to effectively adsorb methyl orange and methylene blue from water,[12] and to adsorb gaseous CH_4, CO_2 and H_2.[13] Studies of the water stability of MOF-235 demonstrate that after contact with water, the $(FeCl_4)^-$ ions detach from the

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Applied Polymer SCIENCE

Laccase-mediated grafting of polyphenols onto cationized cotton fibers to impart UV protection and antioxidant activities

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ABSTRACT: Enzyme-mediated *in situ* functionalization of cotton fibers was studied using laccase. Caffeic acid and morin were used as reactive phenolic substrates for laccase and further employed to the modification of fiber surfaces. Laccase-mediated oxidation and polymerization reactions of caffeic acid were monitored by ultraviolet–visible spectroscopy. During the wetting process, initial cationization of fiber surfaces using poly(diallyldimethylammonium chloride) followed by enzymatic treatment with phenolic substrates resulted ineffective polymer grafting evidenced by high color stability. Changes of fiber surface properties by polymer grafting, such as morphology and hydrophilicity/hydrophobicity, were tested using scanning electron microscopy and gravimetric absorption tests. An acceptable level of color resistance to washing stress was obtained on caffeic acid treated samples, and a high level of rubbing resistance was obtained on samples treated with both caffeic acid and morin. Regarding the ultraviolet protection test, the cationized and enzymatically functionalized samples showed a very good protection grade (ultraviolet protection factor = 25). Finally, the antioxidant activity test of the modified fibers presented an improvement for radical scavenging potential due to the phenolic compounds incorporated to cotton fibers by laccase-mediated catalysis. © 2017 Wiley Periodicals, Inc. J. Appl. Polym. Sci. **2018**, *135*, 45801.

KEYWORDS: applications; catalysts; coatings; polyelectrolytes; textiles

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INTRODUCTION

Polyphenols are found in a variety of dietary plants and characterized with aromatic rings bearing more than one hydroxyl moieties.[1,2] The hydroxyl groups in polyphenol molecules have an essential role in providing antioxidant activity.[3,4] The most common dietary polyphenols are flavonoids and phenolic acids, they are the most important group of secondary metabolites and bioactive compounds in plants and act as protectors against reactive oxygen and nitrogen species, ultraviolet (UV) light, pathogens, etc.[5] Flavonoids are found in the form of β-glucosides and their chemical nature and bioactivities depend on their molecular structure, degree of hydroxylation, substituents and conjugations, and their degree of polymerization.[3,6] They possess great potential as reducing agents, hydrogen-donating antioxidants, and singlet oxygen quenchers.[7,8] Phenolic acids are hydroxylated derivatives of benzoic, and cinnamic acid, they have received great attention as bioactive agents for their antioxidant, antiapoptotic, and anti-inflammatory capacities.[9,10]

The potential applications of both flavonoids and phenolic acids are been broadly studied in the biological, medical, and pharmaceutical areas,[4–6,9] and have also found interest for the modification of raw materials such as cotton and flax fibers to provide them new functionalities, that is, coloration and antioxidant and antimicrobial activities.[11–15] There are studies about modification and/or functionalization of fibers with polyphenols using oxidoreductases such as laccases and peroxidases. Both enzymes catalyze radical generating reactions by reduction and

** Solo se incluyen artículos de miembros de la Sección Química de la PUCP que aparezcan firmados con la afiliación a esta sección, independientemente de si los colaboradores son, o no, de la PUCP desde el 1 de julio de 2018 hasta el 31 de diciembre de 2018 (no se incluyen artículos aceptados en 2018 que aparezcan con fecha de 2019 en la revista). El acceso al artículo depende de la suscripción del usuario a las editoriales correspondientes. Se han incluido solo revistas científicas que se encuentran indexadas en las bases de datos Scopus y Web of Science, de reconocido prestigio internacional.*

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RESEARCH ARTICLE

Journal of Ecology

Structural and defensive roles of angiosperm leaf venation network reticulation across an Andes–Amazon elevation gradient

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Abstract

1. The network of minor veins of angiosperm leaves may include loops (reticulation). Variation in network architecture has been hypothesized to have hydraulic and also structural and defensive functions.
2. We measured venation network trait space in eight dimensions for 136 biomass-dominant angiosperm tree species along a 3,300 m elevation gradient in south-eastern Peru. We then examined the relative importance of multiple ecological and evolutionary predictors of reticulation.
3. Variation in minor venation network reticulation was constrained to three axes,

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A Comparative Study of Linen (Flax) Fibers as Reinforcement of Fly Ash and Clay Brick Powder Based Geopolymers

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Abstract. Geopolymers have great potential for the development of sustainable building

Biomolecular NMR Assignments
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ARTICLE

Backbone chemical shift assignment of macrophage infectivity potentiator virulence factor of *Trypanosoma cruzi*

Juan M. Lopez[1] · Ricardo Antiparra[1,2] · Guy Iippens[3] · Mirko Zimic[2] · Patricia Sheen[2] · Helena Maruenda[1]

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Abstract

Chagas disease is a trypanosomiasis disease inflicted by *Trypanosoma cruzi* parasite. In Latin America, at least 10 million people are infected and annually, 10,000 casualties are deplored. Macrophage infectivity potentiator protein is one of the major virulence factors secreted by *T. cruzi* (TcMIP) in order to infect its host but little is known about its mechanism of action. Studies confer TcMIP an important role in the extracellular matrix transmigration and basal lamina penetration. Here, we report the backbone ^{1}H, ^{13}C, and ^{15}N resonance assignment of TcMIP and the comparison of the secondary structure obtained against reported X-ray crystallography data.

Keywords Macrophage infectivity potentiator · TcMIP · Virulence factor · NMR resonance assignment · *Trypanosoma cruzi* · Prolyl cis trans isomerase · FK506 binding protein · FKBP-like protein

Biological context

American trypanosomiasis also known as Chagas' disease has been postulated as "the archetypal neglected disease" (Grayson 2010) due to the lack of effort displayed worldwide in the discovery of novel and less toxic drugs for its treatment. In Latin America, at least 10 million people are infected and 100 million are at risk of infection, while there are about 10,000 deaths annually (Bernardes et al. 2013). Benznidazole and Nifurtimox, drugs introduced over 40 years ago, are used for the treatment of the chronic phase of the infection. Both have limited efficacy showing 80% failure rates. They are also expensive, require long-period treatments (60, 90 days, respectively), and exert significant side effects (Clayton 2010). As a consequence, Chagas' disease at the chronic stage is still regarded as incurable, causing death due to cardiac failure. Challenges for the development of new drugs abound. In order to explore new therapeutics targets it is crucial to fully understand the mechanism by which infection takes place (de Souza et al. 2010).

An approach not yet exploited is the macrophage infectivity potentiator (MIP) protein from *Trypanosoma cruzi* (TcMIP, 18.8 kDa), recognized in 1995 to play an important role in host cell invasion (Moro et al. 1995). MIP proteins have been reported in different pathogenic bacteria as *Legionella pneumophila* and *Chlamydia trachomatis* but their implication in the pathogenic infectious process is still not fully understood (Lundemose et al. 1992; Wagner et al. 2007; Newton et al. 2010; Ünal et al. 2011). MIP proteins are proline cis–trans isomerases FKBP-like proteins secreted by some pathogenic microorganisms in order to promote host cell invasion (Moro et al. 1995; Ünal and Steinert 2014, 2015).

Studies performed by Moro et al. showed that FK506 and its non immunosupresor derivative L-685,818 are potent inhibitors of trypomastigote epithelial cell invasion, introducing TcMIP as a potential new chemotherapeutic target (Moro et al. 1995). TcMIP is translated with a supplementary 29 amino acid N-terminal signal peptide. These residues interact with the membrane and contribute to its secretory

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Eco-friendly Improvement of Water Erosion Resistance of Unstable Soils with Biodegradable Polymers

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Abstract. The improvement of water erosion resistance of soils is gaining the attention of the scientific community. Erosion represents a threat to agricultural productivity because of the loss of valuable superficial soil and nutrients. Cultivation soils erosion is one of the main contributors to the desertification process, which is, itself, a global problem. Recently, polysaccharides have been tested as additives to improve earth construction materials with respect to their mechanical properties and water erosion resistance. This paper studies the use of biodegradable polymers to improve soil stabilization with respect to erosion by water. Aqueous solutions of the polysaccharides chitosan and carrageenan were used to improve wettability and runoff resistance of sandy and loose soils. Chitosan becomes positively charged when dissolved in dilute acidic solutions, while carrageenan becomes negatively charged. Their capacity to form polyelectrolytes in aqueous solutions may be a contributor in retaining cohesiveness in loose soils.

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Label-free SERS and LSPR gold nanoaptasensors of mycotoxins in solution: solvent assessment

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Abstract: Liquid-phase gold nanoaptasensors were developed for mycotoxin determination down to ppb level. We present selected results of accessible detection of OTA and AFB1 toxins and the solvent effect in the LSPR and SERS bioassay. **OCIS** codes: (240.6695) Surface-enhanced Raman scattering; (240.6680) Surface Plasmons; (280.1415) Biological sensing and sensors.

1. Introduction

Aptamer-based biosensing technology combined with gold nanoparticle optical transducers provide simple, rapid, and reliable detection methods that can be easily integrated with portable and accessible optical equipment. Among them, label-free surface-enhanced Raman scattering (SERS) and localized surface plasmon resonance (LSPR) band shift are two complementary and promising techniques for the chemical analysis of food. Like other unlabeled systems, they have the time, cost and simplicity advantages. While LSPR detects the adsorption of target molecules (e.g. pathogens, pesticides, metabolites, and toxic chemicals in foodstuff; label-free SERS provides direct information of the biomolecular interaction between the aptamer strand and these target molecule. Recent developments in nanotechnology allowed two types of SERS substrates: those based on nanostructured platforms [1] and those based on nanoparticles in suspension [2] (Figure 1) Label-free SERS platforms for mycotoxin detection have barely been reported. The studies available need to overcome accessibility issues, as they rely on expensive equipment, benchtop spectrometers and a clean room facility to prepare the substrates. In contrast, nanoparticle aggregates and anisotropic structures have been prepared as SERS-based systems in suspension These sensors show great potential, as they are simple, easy to operate and low cost. However, controlling AuNPs aggregation and reproducibility on colloids and avoiding false positives are still challenges.

ARTICLES
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Tropical forest leaves may darken in response to climate change

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Tropical forest leaf albedo (reflectance) greatly impacts how much energy the planet absorbs; however; little is known about how it might be impacted by climate change. Here, we measure leaf traits and leaf albedo at ten 1-ha plots along a 3,200-m elevation gradient in Peru. Leaf mass per area (LMA) decreased with warmer temperatures along the elevation gradient; the distribution of LMA was positively skewed at all sites indicating a shift in LMA towards a warmer climate and future reduced tropical LMA. Reduced LMA was significantly ($P < 0.0001$) correlated with reduced leaf near-infrared (NIR) albedo; community-weighted mean NIR albedo significantly ($P < 0.01$) decreased as temperature increased. A potential future 2 °C increase in tropical temperatures could reduce lowland tropical leaf LMA by 6–7 g m^{-2} (5–6%) and reduce leaf NIR albedo by 0.0015–0.002 units. Reduced NIR albedo means that leaves are darker and absorb more of the Sun's energy. Climate simulations indicate this increased absorbed energy will warm tropical forests more at high CO_2 conditions with proportionately more energy going towards heating and less towards evapotranspiration and cloud formation.

Tropical forests are the most important terrestrial biome affecting planetary albedo through both surface effects and impacts on cloud cover, which in turn drive global climate[1]. Humans have already increased the albedo of South American tropical forest regions through land use change, which has increased by 0.0025 albedo units across South America[2]. However, little is known about how tropical forest leaf albedo could be affected by climate change. Tropical forest canopy albedo is principally a function of leaf albedo and leaf area index, with the latter typically high and saturated in terms of its contribution to albedo[3]. Leaf reflectance in the visible (VIS) portion of the solar-reflected spectrum (VIS, 400–700 nm) tends to be driven by leaf traits, such as chlorophyll content, while near-infrared (NIR) leaf reflectance (NIR, 700–2,500 nm) tends to be driven more by structural traits, such as leaf mass per area (LMA)[3–7].

Trait-based ecological scaling theory predicts that plant traits will change in response to increasing global temperatures and provides a basis for evaluating the potential effects on albedo. This theory posits that there is an optimal set of traits to maximize plant growth for any given environment[8–11]. However, in a rapidly changing climate, the extant and optimal trait values may differ and be out of equilibrium. When this occurs, mean trait distributions can be skewed, as they are in the process of shifting towards the optimal trait distributions for the new climate. We recently demonstrated that the distributions of LMA and leaf percentage phosphorus concentration were positively skewed across a series of ten 1-ha plots along an elevation transect in Peru (Supplementary Table 1)[9,12]. This suggested that they had begun their migration towards a new optimal distribution for a warmer world and were not yet in equilibrium. In other words, we expect leaf traits may change everywhere due to a changing climate, but we expect to first see such trends along elevation gradients and within the trait distributions of existing plots. Along the same elevation transect, it has been demonstrated that the mean distribution of many tree genera have shifted upwards[13,14]. However, such upward shifts were fewer than may have been expected based on the large temperature changes that had occurred in the region, a second indication suggesting that the trees are in a state of disequilibrium.

To measure whether traits will continue to shift in sensitive ecosystems, such as tropical montane systems, LMA has been suggested as a proxy for tracking forest response to climate change[12]. This is because changes in LMA have been statistically correlated with changes to temperature, and increased temperatures along a Peruvian elevation gradient led to decreased LMA values[9]. This result was evident in both field results and at multiple spatial scales (0.1–1 ha resolution) using remote sensing[15]. Several other tropical and temperate forest studies have shown similar LMA elevation trends, possibly because cooler and more adverse growing conditions lead to a more conservative plant resource strategy[16–17]. Cold temperatures lead to reduced cell expansion, many small cells per unit area and, thus, more cell wall material per unit leaf volume and more cell layers[18]. More cell layers reduce freezing stress through slowing down the freezing rate[19]. LMA also decreases at higher temperatures, but not at the same rate as at lower temperatures[20].

Leaf structural traits, such as LMA, strongly influence leaf reflectance and transmittance, particularly in tropical forest foliage[21]. LMA is correlated with these structural parameters and (assuming cell walls have a constant weight per unit area) an increase in LMA will increase the cell wall interfaces in a leaf[22]. Leaf reflectance models, such as PROSPECT[5,23,24], simulate leaf reflectance using (among

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