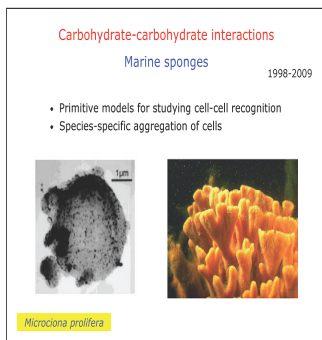




Carbohydrate-Carbohydrate Interactions

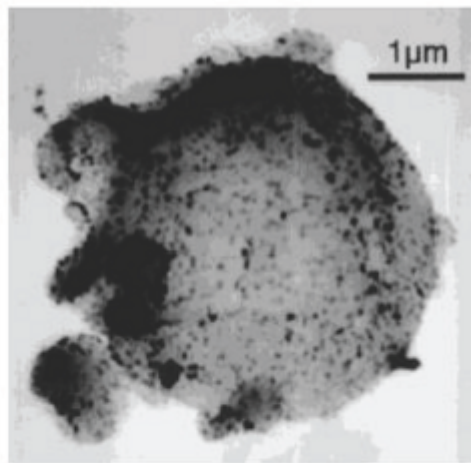
Description

Carbohydrate-carbohydrate interactions

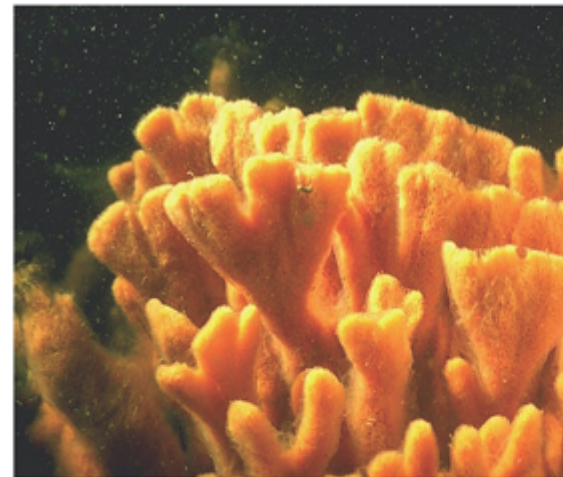
Marine sponges

199

- Primitive models for studying cell-cell recognition
- Species-specific aggregation of cells



Microciona prolifera



- When placed in artificial sea water free of Ca^{2+} ions, **complete dissociation** of the sponge tissue into a suspension of cells occurs.
- Formation of **cell-aggregates** by adding Ca^{2+} to the c suspension; completely functional sponges can be th result.
- Cell-surface proteoglycans underlie the Ca^{2+} -depend molecular mechanism of the self-recognition; coding **aggregation factors** (AF).
- Sponge-species specificity of the aggregation proces **colour-specific sponge cell sorting**. Can be mimicked different coloured beads, coated with species-specific AFs.

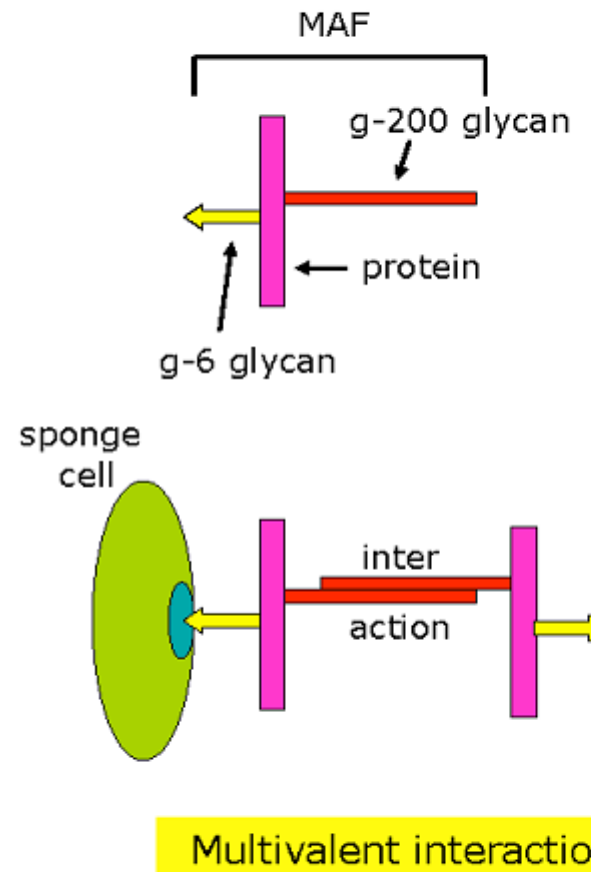
Proposed model for MAF-mediated sponge cell ad

Microciona prolifera

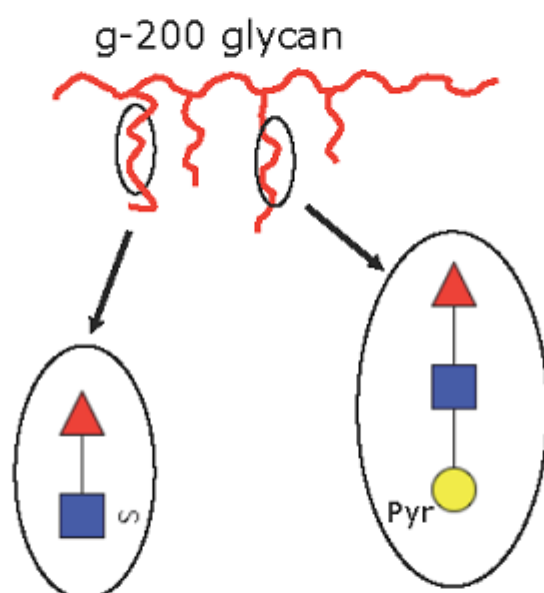
Ca²⁺-independent adherence of g-6 glycans to cell-surface receptors (carbohydrate-protein interaction).

Ca²⁺-dependent self-association of g-200 glycans (carbohydrate-carbohydrate interaction).

Other alkaline earth cations, Mg²⁺, Sr²⁺, Ba²⁺ could not replace Ca²⁺ as an aggregation-mediating agent. The transition elements Mn²⁺ and Cd²⁺ could partially replace Ca²⁺.



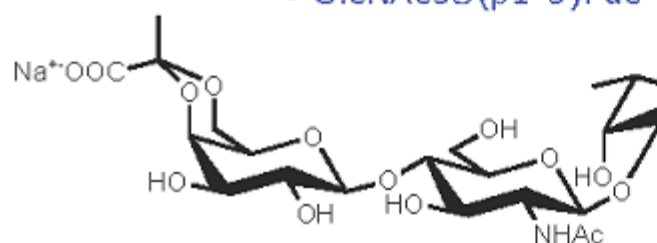
Structural analysis of MAF fragments



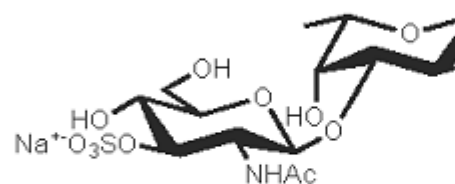
■ = D-GlcNAc ▲ = L-Fuc ● = D-Gal

Two oligosaccharide fragments from *M. prolifera* MAF g-200 by n hydrolysis were shown to be epitopes for the MAF self-recognition (Mab str)

- Gal4,6(R)Pyr(β1-4)GlcNAc(β1-3)Fuc
- GlcNAc3S(β1-3)Fuc



Reactive towards the cell blocking antibody Block 1

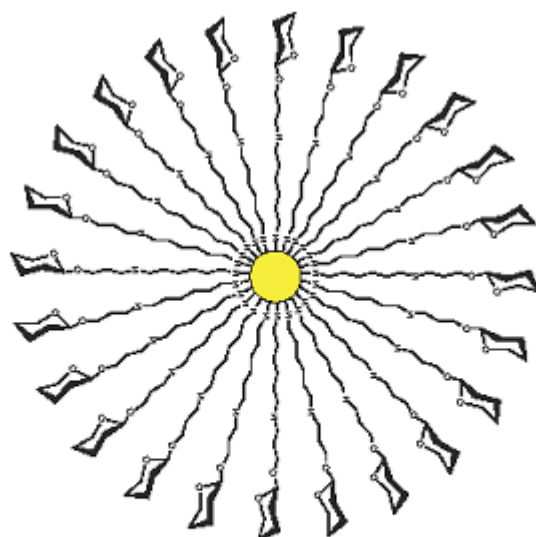


Reactive towards the cell blocking antibody Block 2

Carbohydrate-carbohydrate interactions

Multivalency to overcome low affinity

Gold glyconanoparticles



UV

SPR

NMR

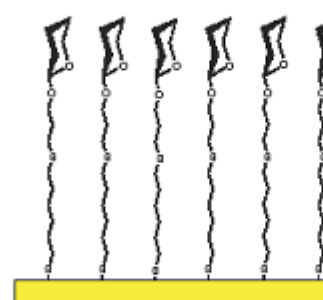
TEM

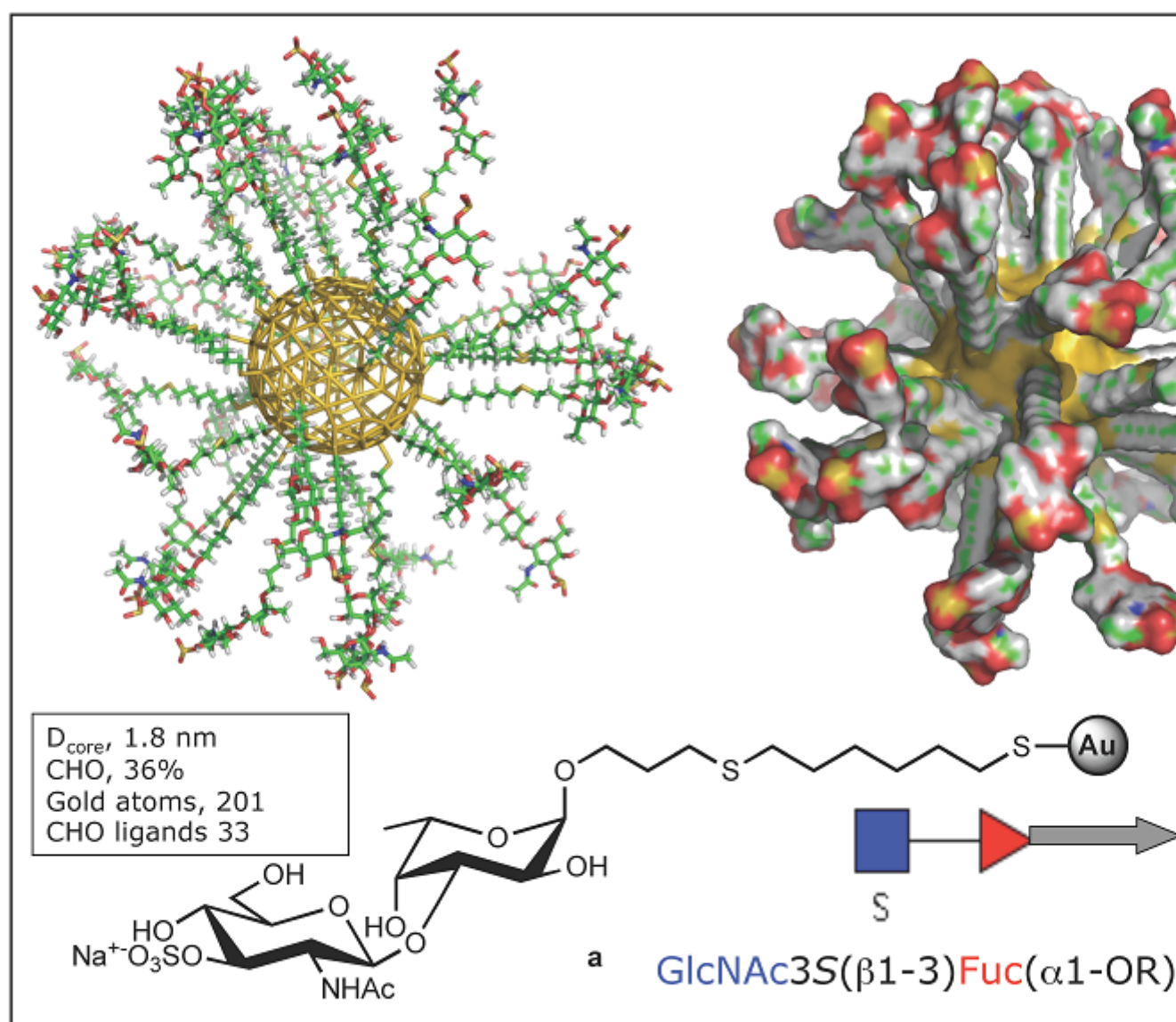
Neoglycoprotein



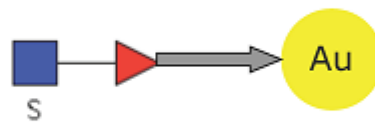
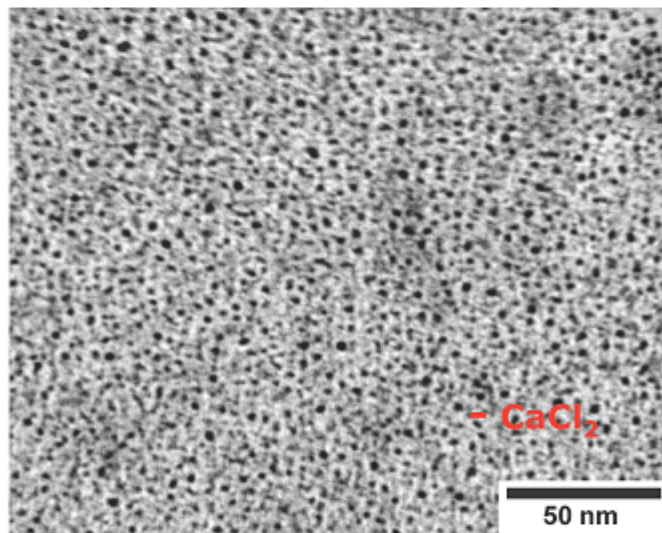
AFM

Gold glycoarray

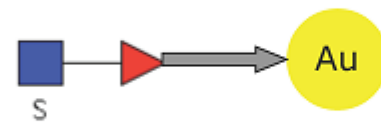
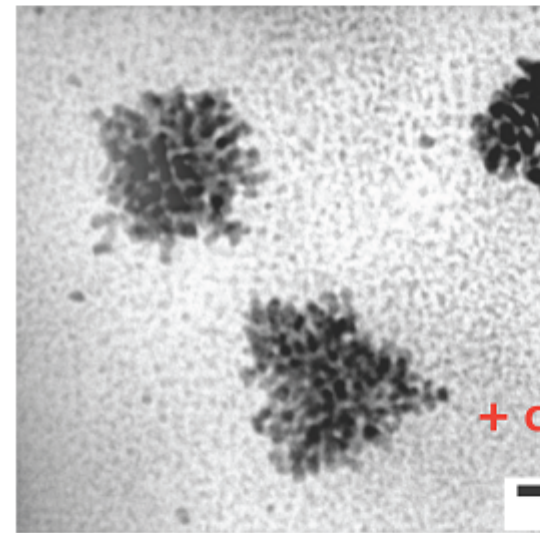




Transmission Electron Microscopy of gold glyconanoparticles



0.1 mg/ml; **without**
calcium ions

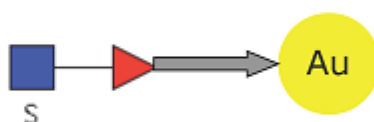
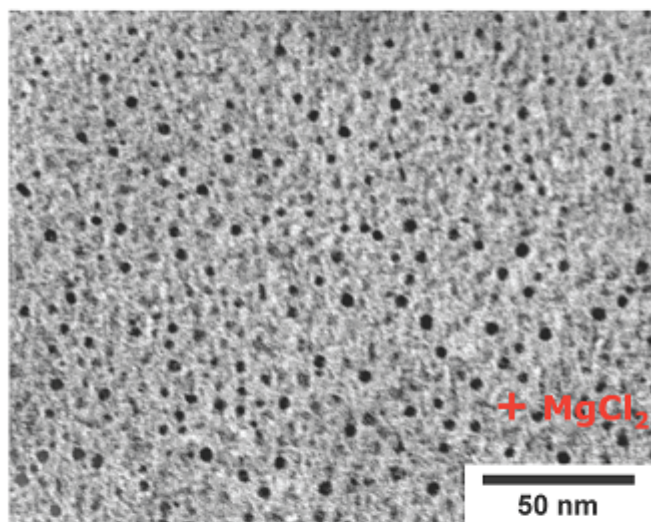


0.1 mg/ml; **with**
calcium ions (10 mM)

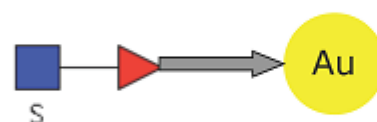
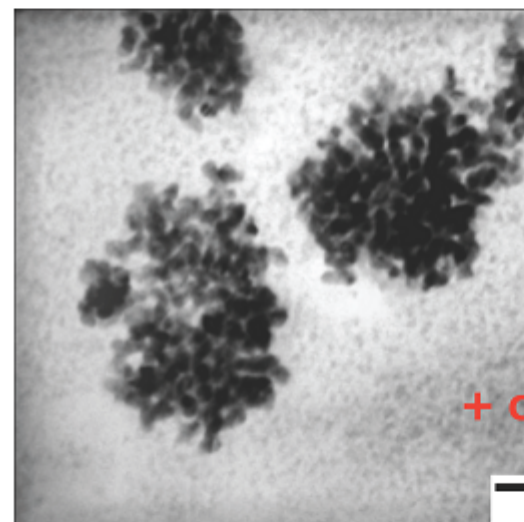
TEM analysis of gold glyconanoparticles

No self-recognition in the presence of MgCl_2 and MnCl_2 .

Weak self-recognition in the presence of CdCl_2 .



0.1 mg/ml; **with**
magnesium ions (10 mM)



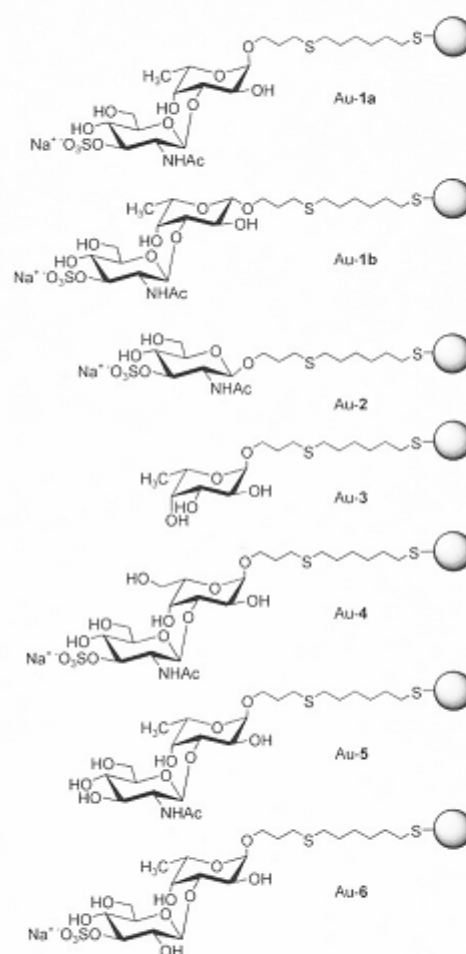
0.1 mg/ml; **with**
calcium ions (10 mM)

Gold Glyconanoparticles as Probes to Explore the Carbohydrate-Mediated Self-Recognition of Marine Sponge Cells

Adriana Carvalho de Souza,^[a] Koen M. Halkes,^[a]
Johannes D. Meeldijk,^[b] Arie J. Verkleij,^[b]
Johannes F. G. Vliegthart,^[a] and
Johannis P. Kamerling^{*(a)}

Cell aggregation in the red-beard marine sponge *Microciona prolifera* is mediated by a 2×10^6 kDa proteoglycan-like macromolecular aggregation factor (MAF), and is based on two highly polyvalent functional properties; a Ca^{2+} -dependent proteoglycan self-interaction and a Ca^{2+} -independent cell-binding activity.^[1–3] MAF, the first circular proteoglycan described, is composed of two *N*-glycosylated proteins, MAFp3 and MAFp4, with twenty units of each glycoprotein forming the central ring and the radiating arms, respectively. Each MAFp3 carries one or two copies of a 200 kDa acidic glycan, g-200, whereas each MAFp4 carries about 50 copies of a 6 kDa glycan, g-6.^[1] The MAFp4 arms of the sunburst-like proteoglycan are linked to cell-surface binding receptors, while the MAFp3 ring exposes the g-200 glycans so that they can engage in the Ca^{2+} -dependent self-association (for a detailed review, see ref. [4]). By making use of MAF-specific monoclonal antibodies, it could be demonstrated that the self-association of MAF occurs through highly repetitive epitopes on the g-200 glycan.^[5,6] One of these epitopes was shown to be the sulfated disaccharide $\text{GlcNAc}3\text{S}(\beta 1-3)\text{Fucp}$.^[7] To gain insight into the role of carbohydrate interactions in MAF self-aggregation, we designed a challenging system for mimicking the g-200 self-association.^[8] By using the synthetic sulfated disaccharide, multivalently presented as a bovine serum albumin conjugate, and surface plasmon resonance spectroscopy, it was shown that Ca^{2+} -dependent carbohydrate self-recognition is a major force in the g-200 association phenomenon.

Gold glyconanoparticles have been successfully used as inert multivalent systems to explore either carbohydrate self-interac-



Scheme 1. Gold glyconanoparticles Au-1 a/b to Au-6, related to the MAF sulfated disaccharide epitope.



Adriana de Souza

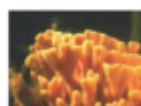
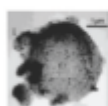
ChemBio
6 (2003)

Carbohydrate-carbohydrate interactions

Marine sponges

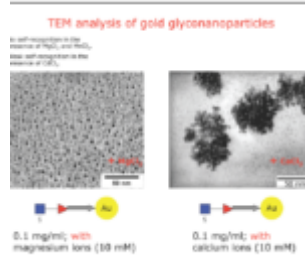
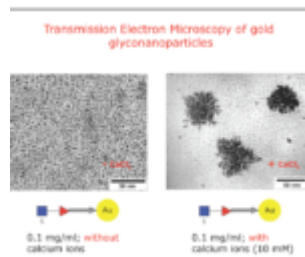
1998-2003

- Primitive models for studying cell-cell recognition
- Species-specific aggregation of cells



Microscopic analysis

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Category

1. News