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TRUKING MICRO-SPHERE

**Truking Micro-sphere Biotechnology Co.
Product manual**

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TA-IMAC FF

Metal Chelate Affinity Chromatography Resin

Product Manual



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1. Product Introduction

TA-IMAC FF is a metal chelating affinity chromatography medium that can be widely used for the separation and purification of proteins and peptides. The principle of TA-IMAC FF is to utilize the interaction of histidine, cysteine and tryptophan side chains of proteins with various transition metal ions, such as Cu^{2+} , Zn^{2+} , Ni^{2+} , Co^{2+} , Fe^{3+} , so as to achieve the purpose of separation and purification.

TA-IMAC FF is made of crosslinked agarose and ammonia triacetic acid (NTA), which can chelate the tetravalent level of metal ions, making the chelated metal ions more stable, tolerating a certain concentration of reducing agent, possessing the advantages of good physical and chemical stability, good specificity, and fast flow rate.

Table 1 TA-IMAC FF technical parameters

| | |
|---|---|
| Appearance | White slurry, layered on placement |
| Base frame | Highly cross-linked 6% agarose |
| Particle Size Distribution Range | 45-165 μm |
| Metal chelating capacity | $\text{Ni}^{2+}/\text{Zn}^{2+}$: 15 $\mu\text{mol/mL}$ media, Cu^{2+} : 25 $\mu\text{mol/mL}$ media |
| Dynamic Binding Load | Ni^{2+} : ~40mg His-tagged protein/mL media |
| Chemical stability (in the absence of chelated metal ions) | 40°C 1 week: 10mM HCl, 0.1M NaOH, 8M urea, 6M guanidine hydrochloride; 40°C 12h: 1M NaOH, 70% acetic acid; |
| Storage | 2~30°C, 20% ethanol or 2% benzyl alcohol |
| Maximum Pressure Resistance | 0.3MPa |
| pH stability | 3-12 (working); 2-14 (CIP, when no chelated metal ions) |
| Recommended Flow Rate | <150cm/h |

2. Methods of use

2.1 Chromatography column loading

Note: It is best to equilibrate the media suspension to room temperature before loading the column.

- Calculate the amount of TA-IMAC FF needed based on the volume of the chromatography columns

Settling volume required = column volume \times 1.15 (i.e., compression ratio of approximately 1.15)

Volume of media suspension required = volume of settling media \div concentration of media suspension.

Note: The concentration of Truking Microsphere's original packaging media suspension is 80%, for non-original concentration of media suspension, customers can calculate the required volume according to the actual concentration of media suspension.

- **Media washing:** Shake the media suspension well and measure the volume calculated by the above method, pour it into a funnel, draw off the liquid and wash it with about 3mL of purified water/mL of media, repeat the washing 3 times, each time when adding the washing liquid, you need to use a glass rod or stirring stick to stir, in order to wash off the original preservation liquid better.
- **Preparation of Column Mounting Gel Suspension:** Transfer the cleaned medium from the funnel to a beaker or other suitable container, add the column mounting solution until the concentration of the gel suspension is 50~75%, stir well and set aside.
- Take a cleaned TK-EC chromatography column (the diameter of TK-EC series chromatography columns ranges from 1cm to 45cm in various specifications to meet the different sizes of chromatography applications), drain the membrane air bubbles at the bottom of the column and keep about 1cm high liquid column at the bottom of the column, and adjust the column so that it is perpendicular to the ground.
- Pour the stirred gel suspension slowly into the chromatography column one at a time, taking care not to bring in air bubbles.
- Connect the upper column head to the chromatography system or peristaltic pump, drain the air bubbles under the screen of the upper column head (for the chromatography column with diameter less than 20cm, you can use the peristaltic pump or the earwash ball to suck out the air bubbles under the screen after turning the column head upwards), put the column head into the chromatography column, shake the column head so that the air bubbles can be discharged from the edge of the column head, and then screw the sealing knob tightly. (For the chromatography column with diameter >30cm, do not tighten the sealing ring too much, press down the head of the shaft to let the liquid inside the column back out through the column head to discharge the air bubbles inside the column head, and then tighten the sealing knob).
- Set the flow rate (TA-IMAC FF can be set to 75cm/h for a loading height of 10~20cm), open the bottom valve/plug of the chromatography column, turn on the flow rate, and use the set flow rate to press until the adhesive surface is clear and stable, and mark the position of the adhesive surface when it stabilizes.
- Remove the column loader (if any), install the upper column head, lower the column head to about 0.5cm above the gel surface, set the flow rate to 300cm/h and continue to press the column until the gel surface is clear and stable, mark the column height when the gel surface is stable.
- Stop the pump, open the valve/plug on the column head, close the valve/plug at the bottom of the column, slightly relax the sealing ring of the column head, press down the column head to about 0.3cm below the marked position, tighten the sealing ring of the column head, close the valve/plug at the column head, and the installation of the column is completed.

2.2 Column Effectiveness Evaluation

Column efficiency can be determined by using acetone as indicator or NaCl as indicator, and the indicator solution and mobile phase are prepared according to the following table.

Table 2: Column efficiency determination methods

| Methods | Acetone Method for Column Efficacy | Column Efficacy by NaCl Method |
|-----------------------|------------------------------------|--------------------------------|
| Sample | 1.0% (v/v) acetone in water | 0.8M NaCl (dissolved in water) |
| Sample volume | 1.0% column volume | 1.0% column volume |
| Mobile phase | Water | 0.4M NaCl aqueous solution |
| Flow rate | 30 cm/h | 30 cm/h |
| Detection Data | UV 280 nm | Conductivity |

2.3 Calculating Column Effect

Theoretical plate height (HETP), theoretical number of plates (N) and asymmetry factor (As) were calculated from the UV or conductivity curves with the following equations:

$$\text{HETP} = L/N$$

$$N = 5.54(V_R/W_h)^2$$

Where: V_R = retained volume

W_h = half peak width

L = column height

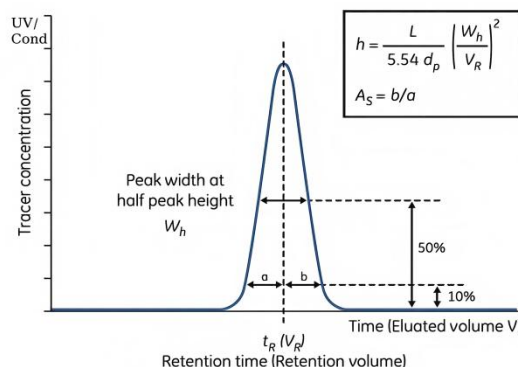
N = theoretical plate number

The units of V_R and W_h should be the same;

$$A_s = b/a$$

Where: a = first half peak width at 10% peak height

b = second half peak width at 10% peak height



2.4 Evaluation of results

$$h = \text{HETP}/d_{50v}$$

d_{50v} = median particle size volume distribution (cm)

The h -value calculated by the above formula is less than 3, and the asymmetry factor is 0.8~1.8 then it is judged to be qualified. For unsatisfactory column efficiency the reason needs to be analyzed and the column reloaded.

2.5 Chromatographic methods

● Chelate metal ions:

- Flush 5 column volumes with purified water;
- Rinse 5 column volumes with equilibration buffer;
- Rinse 5 column volumes with purified water;
- Pass the column through 5 column volumes of 100 mM metal ion solution;
- Remove unbound metal ions with 10 column volumes of equilibration buffer;
- Rinse 10 column volumes with purified water;
- Wash the column with 10 column volumes of elution buffer;
- Equilibrate the column with Equilibration Buffer and set aside.

The general environment for metal ions is neutral (pH 7~8). Choose $\text{pH} \leq 5.5$ for zinc ions to avoid solubility of high pH salts and $\text{pH} \approx 3$ for iron ions to avoid formation of insoluble species.

- **Buffer:** preferred phosphate buffer, pH neutral to weakly alkaline (7~8), avoid EDTA and citrate, etc. Tris-HCl can also be used, but should be avoided in the case of metal ions and protein affinity is very weak. Commonly added reagents and concentrations that do not affect and affect metal chelation chromatography are listed in Tables 3 and 4, respectively.

- *In order to reduce the nonspecific binding of host proteins to the medium, low concentrations of imidazole (20-40 mM) are commonly added to equilibration buffers and samples.*
- *0.15~0.5M NaCl must be added to the buffer to eliminate ion exchange.*

Table 3 Additions that do not affect protein binding to immobilized metal ion affinity media

| Additives | Common Concentration | Additives | Common Concentration |
|-------------------------------------|----------------------|--------------------------------------|----------------------|
| Phosphate, Borate, HEPES | 20-100mmol/L | Nonionic Stain Remover | 2% |
| NaCl | 2mol/L | Triton X-100 | 2% |
| KCl | 1mol/L | Tween-20 | 2% |
| Guanidine hydrochloride | 6mol/L | Octyl Glucoside | 2% |
| Urea | 8mol/L | Dodecyl maltoside | 2% |
| Glycerol | 50% | C12E8 ,C10E6 | 2% |
| Isopropyl alcohol | 60% | PMSF(Protease Inhibitor) | 1mmol/L |
| Ethanol | 30% | Pepsin Inhibitor(Protease Inhibitor) | 1μmol/L |
| Amphoteric decontaminants (CHAPS) | 1% | Leucineurin(Protease inhibitor) | 0.5μg/mL |
| Benzamidine 1% (protease inhibitor) | 1mmol/L | / | / |

Table 4 Additives that have the potential to disrupt protein binding to immobilized metal ion affinity media

| Additives | Common Concentration | Additives | Common Concentration |
|--------------------------------------|--|-------------------|----------------------------------|
| 2-Mercaptoethanol | 20mmol/L | Histidine | Can be used to replace imidazole |
| Strong reducing agents (DTT and DTE) | 0.1mmol/L | Glycine | — |
| Chelating agent (EDTA and EGTA) | 0.1 mmol/L, competition for Ni ²⁺ from the medium | Glutamine | — |
| Ionic decontaminants (cholate, SDS) | — | Arginine | — |
| Sodium azide | 3mmol/L | Ammonium chloride | — |
| Citrate | Tolerates low concentrations | — | — |

- **Flow rate:** for the height of the column in the case of 10~20cm high can choose <150cm/h flow rate, column height increases need to reduce the flow rate appropriately.

- **Sample Preparation and Sample Volume:** To prevent the sample from clogging the column, the sample needs to be filtered through a 0.45 μm microporous filter membrane and the pH and conductivity of the sample adjusted to be consistent with the equilibration buffer prior to sampling. Factors such as equilibrium solution and imidazole concentration affect the sample volume of TA-IMAC FF.
- **Equilibration:** Wash the column with Equilibration Buffer until the pH, conductivity, and UV of the effluent are the same as the equilibration solution. To minimize the effect of metal ion shedding on the chromatography, it is recommended that the column be washed with 1 column volume of 0.5M imidazole containing 1M NaCl prior to equilibration, followed by 5 column volumes of purified water, and then finally equilibrate the column with equilibration buffer before sampling.
- **Sampling:** The volume of the sample is determined according to the content of the substance in the sample and the binding capacity of TA-IMAC FF, and the sample is loaded.
- **Wash:** Wash the chromatography column with equilibration buffer until the UV absorption is close to the baseline.
- **Elution:**
 - Competitive elution: linear or gradual increase in the concentration of substances with affinity for the metal ion, e.g., 0~2M NH_4Cl , 0~0.5M imidazole, 0~0.5M histidine. Gradient elution is best performed at a constant pH of the equilibration buffer.
 - Can lower the pH of the buffer for elution: as the pH is lowered, weakly bound and strongly bound proteins are eluted sequentially. When the pH of the buffer is lowered below 4, the metal ions dissociate from the medium and are eluted. (If the target protein is sensitive to low pH, it is recommended to add 1/10 volume of 1M Tris-HCl, pH 9.0, to the elution collection solution for neutralization).
 - *A 0.05M solution of the chelating agent EGTA or EDTA can dissociate the metal ions from the medium for elution purposes, and this method can also be used to elute denatured or precipitated proteins. This method is generally not recommended. Ni^{2+} in the eluted product can be removed with a desalting column. The medium can be re-saturated with 0.2M NiSO_4 .*
- **Regeneration:** Impurity residues and metal ion shedding will affect the chromatographic performance and loading of the column. It is recommended to re-chelate the metal ions after every 1~5 cycles depending on the production needs.
 - Nickel removal with 2~5 column volumes of nickel removal buffer (50mM PB, 0.5M NaCl, 0.1~0.2M EDTA, pH 7.0);
 - Run with 2~3 column volumes of 0.5M NaCl to remove residual EDTA;
 - Treat with 0.5 column volume of 0.2M NiSO_4 ;
 - Unbound metal ions were removed with 5 column volumes of purified water;
 - The column was washed with 5 column volumes of elution buffer;
 - Equilibrate the column with equilibration buffer and set aside.

3. Cleaning and regeneration

As the number of times the chromatography medium is used increases, the accumulation of contaminants on the chromatography column also increases. Regular in-situ cleaning can effectively prevent the accumulation of contaminants and maintain the stable working condition of the chromatography medium. Customers can determine the frequency of in-situ cleaning according to the degree of contamination of the media during use (if the contamination is more serious, it is recommended to carry out in-situ cleaning after each use to ensure the reproducibility of the results).

- Nickel ions were removed first.
- Removal of proteins adsorbed due to ion exchange: Wash the column with 2~3 column volumes of 2M NaCl solution, and then wash the column with 3 times the volume of purified water in the column bed.
- Removal of precipitated or denatured substances: Treat with 1M NaOH for 0.5~1h.
- Removal of hydrophobically bound substances: Wash the column with 2 column volumes of 70% ethanol or 30% isopropanol, and immediately reverse with at least 5 column volumes of sterile equilibration buffer.

4. Sterilization and storage

Since 20% ethanol or 2% benzyl alcohol preservation solution does not have sterilization and de-pyrogenic effect, it is recommended that TA-IMAC FF media can be treated with 70% ethanol for more than 12h before and during use, or the media after nickel removal can be treated with 1M NaOH for 0.5~1h to reduce the risk of microbial contamination.

TA-IMAC FF media are sold with 20% ethanol or 2% benzyl alcohol as a preservation solution. After use, TA-IMAC FF is stored in 20% ethanol at 2-30°C in an airtight container. It is recommended that the preservative be replaced with fresh preservative every 3 months to prevent evaporation of ethanol and microbial growth.

5. Destruction and recycling

Since TA-IMAC FF is difficult to degrade in nature, incineration is recommended for environmental protection.

6. Ordering Information

Table 5 Article number and packaging

| Product | Item No. | Norm |
|------------|----------|-------|
| TA-IMAC FF | Y5029 | 25mL |
| | Y5030 | 100mL |
| | Y5031 | 500mL |
| | Y5032 | 1L |
| | Y5033 | 5L |
| | Y5034 | 10L |
| | Y5035 | 20L |